A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

APRIL, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

1367. Nuclear Structure of Light Atoms. B. M. Sen. *Indian Journ. Phys.* 11. *pp.* 427–432, *Jan.*, 1938.—It is suggested that the nucleus may be regarded as a kind of crystalline structure rather than an ensemble of protons and neutrons, as a static or at any rate a quasi-static system, rather than dynamical. The principles and methods of quantum mechanics have not, therefore, been applied. Born's unitary theory gives a field which differs only slightly from the Coulomb field, which may be supposed to be playing an important rôle in the nuclear structure. On this hypothesis, it has been shown that the ratio between two fundamental distances in the assumed structure for α-particles lies between two narrow limits. Calculations from mass-defects give the distance between elementary particles of the nucleus as of order 10^{-14} cm., the figure generally accepted. The structure of the isotopes of H, He and Li has also been considered. Since the identity of the different elementary particles of the nucleus of the same isotope is denied, the difficulty about the continuous energy-spectrum of β-radiation seems to admit of a simple solution. AUTHOR.

1368. Nuclear Photo-Effects. N. Bohr. *Nature*, 141. *pp.* 326–327, *Feb.* 19, 1938.—Contrary to expectations, γ-rays of 17 million volts energy eject neutrons from the nuclei of some of the heavier elements only. The author suggests that this selective behaviour is conditioned by "certain special vibratory motions with singular radiation properties" and these, together with other possible modes of vibration, lead to an energy distribution analogous to that of the heat motions in a solid body at a low temperature. The radiative properties of the nucleus in this state will resemble that of a black body with a temperature of several million volts. Based on this analogy he gives a formula of selective absorption, relating the cross-section for nuclear photo-effects with the frequency of the incident γ-rays and the probabilities for the re-emission of a quantum. AUTHOR.

1369. Theory of Showers of Protons and Neutrons. L. Goldstein. *Comptes Rendus*, 206. *pp.* 488–490, *Feb.* 14, 1938.—The idea that the neutrons and protons in a nucleus may be regarded as an intranuclear gas [see Abstract 902 (1938)] is applied to the description of the disappearance of highly activated nuclear energy levels accompanied by expulsion of several heavy particles from the excited nucleus. C. A. S.

1370. Binding Energy of the Deuteron. H. A. Bethe. *Phys. Rev.* 53. *pp.* 313–314, *Feb.* 15, 1938.—Applying the range-energy relations obtained for protons in air by Parkinson, Herb, Bellamy and Hudson [see Abstract 4188 (1937)] to the results of Chadwick, Feather and Bretscher on the photodisintegration of the deuteron [see Abstract 335 (1938)], the following results were obtained: (1) binding energy of the deuteron =

2·17 ± 0·04 eMV ; (2) mass of the neutron = 1·00893 ± 0·00005. The masses of all nuclei which involve a knowledge of the mass of the neutron, should be corrected. Important examples are He^3 = 3·01711, C^{14} = 14·00763 and N^{13} = 13·01008. F. C. C.

1371. Isotopic Constitution of Calcium, Titanium, Sulphur and Argon. A. O. Nier. *Phys. Rev.* 53. *pp.* 282–286, *Feb.* 15, 1938.—A mass-spectrographic study of the isotopic constitution of Ca, Ti, and S has been made. Two new Ca isotopes, Ca^{46} and Ca^{48}, were found, present with abundances 1/29000 and 1/520 that of Ca^{40}, respectively. No new Ti isotopes were found. A new S isotope, S^{36}, was discovered, having an abundance 1/6000 that of S^{32}. The proof for the existence of the new isotopes is presented. The relative abundances of the isotopes in these three elements were determined. A search for other possible rare isotopes was made in all mass number positions in the immediate neighbourhood of the known isotopes. Upper limits for the existence of these hypothetical isotopes are given. A search was made for A^{42}. AUTHOR.

1372. Ratio C^{12}: C^{13} of Isotopes in Diamond. R. Frerichs. *Zeits. f. phys. Chem.* 181. *Abt.A.* 5. *pp.* 355–358, 1938.—The author compares the Swan bands of ordinary CO_2 with those of CO_2 which was produced by burning diamond in pure O_2. He uses two similar discharge tubes and a glass-spectrograph of approximately 20 Å./mm. dispersion. The bands are not resolved. The bands 4737 of the $C^{12}C^{12}$ molecule and 4744 of $C^{12}C^{13}$ are compared for both kinds of CO_2, and no appreciable differences are found. It follows that the ratio of the isotopes C^{12}:C^{13} in diamond cannot be very different from that found for other modifications of C. L. K.

***1373. Manipulation of the Farkas Microthermal Conductivity Analysis Apparatus. H. F. Walton.** *Faraday Soc., Trans.* 34. *pp.* 450–451, *March,* 1938.—The technique of operation of the apparatus described by A. and L. Farkas and P. Harteck [see Abstract 1775 (1934)] for analysis of small quantities of mixtures of the H isotopes presents certain difficulties, of which the chief are the maintenance of the surface of the fine wire of the conductivity bulb in a steady condition for heat transfer, and the avoidance of any separation of the H_2–D_2 mixtures in the apparatus due to their different diffusion rates. Methods for overcoming these difficulties have been noted by various workers. A simpler technique has been evolved and is now described. AUTHOR.

1374. Bond Character and Interatomic Distance. J. M. Robertson. *Chem. Soc., J. pp.* 131–138, *Jan.,* 1938.—In this discussion the author tries to show how really accurate measurements of interatomic distances by diffraction methods can be used as an experimental test of some of the new developments in theoretical chemistry which are becoming so important. After reviewing available methods the author then deals chiefly with particular C–C distances which are of interest in connection with the problem of resonance in certain aromatic and conjugated systems. These distances are: diamond (1·54 Å), diphenyl, phthalocyanines (1·48-1·49), stilbene (1·44-1·45), oxalic acid (1·43), graphite (1·42), naphthalene, anthracene (1·41), tolan (1·40), benzene (1·39), stilbene (1·33-1·35), ethylene (1·33, double bond) and acetylene, tolan (1·20, triple bond). The work of Pauling, Brockway and Beach is discussed with respect to the degree of resonance in the molecules concerned, and it is seen how the conception of the fractional character of a bond enables the classification of the results of the interatomic-distance measurements to be

used for the above purpose. The quantitative character of recent work is shown to afford a basis for predicting distances in other molecules, and for illustration the naphthalene problem is discussed at considerable length.
H. H. Ho.

1375. Properties of Carbon-Halogen Bond in Aliphatic Compounds. J. M. Stevels. *Faraday Soc., Trans.* 34. *pp.* 429–432, *March*, 1938.—The relation between the strength of the bond C–X (in which X represents a halogen atom), the refraction of the atom X, the partial dipole moment C–X, the " restoring force constant " of the bond C–X, and the reactivity of the atom X, are shown. The relation holds for different types of organic halides. AUTHOR.

1376. Resonance and Mesomerism. C. K. Ingold. *Nature*, 141. *pp.* 314–318, *Feb.* 19, 1938.—As a mechanical analogy, time graphs are shown illustrating the behaviour of uncoupled and coupled pendulums which are compared with quantum mechanical resonance and a schematic representation of the formation of one electron bond with a representation of mesomerism in the amidinium ion and finally the splitting of energy levels. In general, mesomerism arises when with nuclei in fixed positions, several structural formulæ can be written. Examples of notation are shown of the three ways of expressing the intermediate character of the electron distribution in a mesomeric system. One way is to write down the various " paper-formulæ " and to add a statement that the real formula is a mean between them. A second is to write one paper-formula and attach curved arrows to it to show the direction it requires to be corrected. A third is to introduce a curved bond sign for each non-localised electron pair. Pauling and Sherman [see Abstract 4720 (1933)] have shown that the resonance energy is negative and varies from quite small values up to several electron volts. The energy effect of mesomerism has been calculated by Pauling and Wheland [see Abstract 3288 (1933)]. T. A. C.

1377. Molecular Structure of Gaseous ZnI_2 and CdI_2. O. Hassel and L. C. Strömme. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 466–468, 1938.—The vapours of ZnI_2 and CdI_2 were examined at above 400° by the electron-diffraction method. Both compounds have a symmetrical linear structure, I–Zn(Cd)–I, with $Zn–I = 2{\cdot}42$ Å, and $Cd–I = 2{\cdot}60$, both $\pm 0{\cdot}02$. C. A. S.

1378. Structure of Silicochloroform. M. H. Pirenne. *Comptes Rendus*, 206. *pp.* 516–517, *Feb.* 14, 1938.—X-ray examination of the vapour of $SiHCl_3$ indicated a non-planar structure for the group $SiCl_3$ with the distances $Cl–Cl = 3{\cdot}27 \pm 0{\cdot}03$ Å, $Si–Cl = 1{\cdot}98 \pm 0{\cdot}02$ Å, and the angle $Cl–Si–Cl = 14{\cdot}5 \pm 1°$. C. A. S.

1379. Molecular Structures of Isobutane, *t*-Butyl Chloride and *t*-Butyl Bromide. J. Y. Beach and D. P. Stevenson. *Am. Chem. Soc., J.* 60. *pp.* 475–481, *Feb.*, 1938.—The molecular structures of isobutane, *t*-butyl chloride and *t*-butyl bromide have been determined by electron diffraction. The C–C–C angles are 113° 30′ ± 2°, 111° 30′ ± 2° and 111° 30′ ± 2° for isobutane, *t*-butyl chloride and *t*-buytl bromide, respectively. The interatomic distances are C–C $1{\cdot}54 \pm 0{\cdot}02$ Å, C–Cl $1{\cdot}78 \pm 0{\cdot}03$ Å, and C–Br $1{\cdot}92 \pm 0{\cdot}03$ Å. The steric repulsions between hydrogen and halogen are calculated and compared with the electrostatic interactions. AUTHORS.

1380. Allotropy of Neodymium. F. M. Jaeger, J. A. Bottema and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 41. 2. *pp.* 120–138, 1938.—The specific heats, the electrical resistance, the internal thermo-

electrical effect and the thermal expansion of Nd at various temperatures were investigated. From the total of all data thus obtained, it becomes evident that Nd—like Ce, La (and didymium)—is at least tetramorphous, its successive transition points being situated at −164° C., + 508° C. and + 714° C., respectively. The phase-transitions occurring between 500° C. and 720° C. are accompanied by more or less strongly pronounced retardation-phenomena which—at least for the greater part—are doubtlessly connected with the rather sluggish re-establishments of dynamical equilibria between the different forms of the metal in the successive phases. Nd heated above 740° C. expands on cooling as low as 640° C. and then obtains a permanent elongation, which proves to possess an accumulative character every time that the experiment is repeated.
AUTHORS.

See also Abstracts 1383, 1586, 1676, 1696, 1724, 1737.

COLLOIDS.

1381. Formation and Solvation of Two-Dimensional Colloids. P. F. Pokhil, T. J. Silberman and D. L. Talmud. *Acta Physicochimica*, 7. 6. *pp.* 849–866, 1937. *In English.*—Methods have been elaborated: (*a*) for obtaining two-dimensional colloids by means of condensation in the process of double decomposition, and (*b*) for measuring the kinetics of the formation of two-dimensional colloids according to the decrease in the surface pressure of monolayers, due to the aggregation of molecules in the latter. Numerous curves of the kinetics of formation of two-dimensional colloids at different concentrations of the participating electrolyte have been taken over a range of from 0·0001 to 1·0 mol./l. On the basis of these measurements, the total number of aggregating molecules in the monolayer has been calculated and the order of size for the particles of the two-dimensional colloid formed then determined. Individual aggregates are found to contain about 1000 molecules each. The formation and properties of a two-dimensional colloid are connected with the solvation of the polar groups in the monolayer and with the adsorption of the excess ions of a given charge. H. H. Ho.

1382. Hydrosol of the Magnetic Oxide of Iron. T. Katsurai. *Kolloid Zeits.* 82. *pp.* 172–174, *Feb.*, 1938.—Experimental details are first given for the preparation of the hydrosol of the magnetic oxide of iron by a method involving the use of supersonic waves. Based on certain assumptions, a differential equation is then derived for the sedimentation and diffusion of ferromagnetic colloids in the magnetic field. H. H. Ho.

1383. Molecular Weight and Viscosity of Polymers. H. Staudinger. *Kolloid Zeits.* 82. *pp.* 129–131, *Feb.*, 1938.—This paper is supplementary to, and critical of, Dobry's recent publication [see Abstract 14 (1938)] on the osmotic and viscosimetric data afforded by cellulose derivatives and polystyrenes. The present author finds that by chemical investigations such as the transformation of polymeric substances into analogous polymerised products, it may be decided whether the colloidal particles form macromolecules or micelles; moreover, the magnitude of the macromolecules may be determined from osmotic data and their shape deduced by viscosimetric experiments. In the case of fibre molecules, their molecular magnitudes may be determined from viscosity data.
H. H. Ho.

***1384. Load-Compression Characteristics of Gelatins, Fibres, and Other Materials. E. J. Saxl.** *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp.* 82–86, *Feb.* 15, 1938.—The qualities of gelatins, jellies, and similar materials, are physically determined by gel strength, gel factor, yield point, elastic hysteresis, etc. The author has developed a precision apparatus with which it is possible to determine these characteristics with an exactness of four significant figures under reproducible conditions in a simple manner. The method and the instrument lend themselves also to measurements of food products, greases, canned and cooked fruits and vegetables, and other plastic and semi-plastic materials. In many instances the universal gelometer effectively supplements findings obtained by plastometers, compressometers, elastometers, and stiffness testers. AUTHOR.

1385. Measurement of Thixotropy in Absolute Units. C. F. Goodeve and G. W. Whitfield. *Faraday Soc., Trans.* 34. *pp.* 511–520, *March*, 1938.—It has been shown that a kinetic treatment of thixotropy (one type of anomalous viscosity) leads to a method of measurement involving a steady state in which the spontaneous growth of internal structure is compensated by a break-down process arising from a steady applied shear. The resistance to flow in the steady state is governed by two parameters, a coefficient of thixotropy and a coefficient for the residual viscosity. Measurements made on carbon black suspensions using a new type of apparatus, together with measurements made by previous observers, are shown to be in conformity with the theory. AUTHORS.

1386. Spinnability of Liquids. H. Erbring. *Kolloid Zeits.* 82. *pp.* 132–134, *Feb.*, 1938.—This paper deals with some experimental observations on polystyrene fibres, and continues previous work on solutions of lyophilic colloids under such conditions that spinning is possible [see Abstract 4280 (1937)]. During spinning, the plastic liquid polystyrene fibres exhibit double refraction, which is produced by the alignment of the nearest isotropic structures in the direction of extension; the structure for the solid fibre is thus already in being in the liquid state. According to the speed with which they are drawn, polystyrene fibres exhibit various frame structures of the fibre and this structure is the more complete at the greater velocities. By external factors such as rotation during spinning, the fibre structure is influenced in the direction of turning; also the stretching of such helical fibres causes the imposed structure to possess greater permanence. This device has certain similarities with the methods used during tension-spinning processes for obtaining crimp or wavy fibres. H. H. Ho.

1387. Viscosity of Oil-Water Emulsions. G. Broughton and L. Squires. *J. Phys. Chem.* 42. *pp.* 253–263, *Feb.*, 1938.—The viscosity of a concentrated emulsion is a function of the rate of shear, approaching an asymptote as the rate of shear is increased. Over wide ranges the relation between shearing stress and rate of shear is linear. For a given emulsion, *i.e.*, a given phase pair and stabiliser concentration (based on the dispersing medium), the limiting viscosity at infinite rate of shear increases with the volume concentration of the disperse phase. The quantitative relation between the concentration and the limiting viscosity is best represented by a modified form of the Richardson equation. The Hatschek equation, as modified by Sibree, does not apply. Other than volumetric concentration, the type of stabiliser employed seems to be the variable of most significance in determining the magnitude of the viscosity of any phase pair. Stabilisers producing the best emulsification give emulsions of the lowest limiting relative viscosity. AUTHORS.

1388. Charged Colloid Particles in an Ultrasonic Field. J. J. Hermans. *Phil. Mag.* 25. *pp.* 426–438, *March*, 1938.—If a plane sonic wave moves in the solution of colloid particles, these particles will lag behind their surroundings because of their inertia. The diffuse double layer round a particle loses its spherical symmetry, and so gives rise to a dipolar moment. Summing up these dipolar moments for all the particles a p.d. ϕ between a node and an antinode of the sonic wave is obtained. Two extreme cases may be distinguished: (1) The dimensions of the diffuse double layer are large as compared with the radius of the particle, and (2) these dimensions are small as compared with the particle. In this paper only the first case has been considered. The resulting p.d. ϕ, which proves to be proportional to the apparent mass $m - Vs_0$ of the particles and to their charge e, may amount to about 0·01 V. It seems that a p.d. which has this order of magnitude may easily be measured, thus leading to interesting information about mass and charge of colloidal particles. AUTHOR.

1389. Structure of Cellulose and Rubber. H. Mark and K. H. Meyer. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 395–399, 1938.—In an earlier paper [see Abstract 3828 (1937)] the authors criticise the results of Sauter on the structure of cellulose suggesting that his experimental method was faulty and his application of crystal structure theory unsound. The authors now claim that similar criticisms can be levelled against Sauter's work on rubber [see Abstracts 4276 and 4277 (1937)]. J. I.

1390. Structure of Stretched Rubber. C. J. B. Clews and F. Schoszberger. *Roy. Soc., Proc.* 164*A. pp.* 491–496, *Feb.* 18, 1938.—A picture of the micellar structure of high polymeric substances is developed which is intermediate between the two formerly proposed theories. The micelles are of lath-shaped form but probably not closed on all sides, and possess, on account of their shape and of their transverse bindings, a definite individuality, even though the *Hauptvalenzketten* themselves extend beyond the sphere of single micelles. The phenomenon of "higher orientation" has been studied in a number of rubber films produced from solutions of a raw rubber and of first latex crepe in benzene, chloroform and carbon tetrachloride. By "higher orientation" is meant an ordering of the crystalline regions so that they are parallel not only to the long axis, but also in a second crystallographic direction. All the films showed "higher orientation" in extreme extension to 700%. The effect also appears with a film of vulcanised rubber. The results establish that the capacity for building up lath-shaped micelles is an intrinsic property of the *Hauptvalenzketten* and not a characteristic of naturally occurring conditions. C. J. B. C.

1391. X-Ray Study of Stretched Rubber. H. A. Morss, Jr. *Am. Chem. Soc., J.* 60. *pp.* 237–241, *Feb.*, 1938.—With the more extensive data from new X-ray films of the diffraction pattern of stretched rubber made in a cylindrical camera, an attempt has been made to find the true unit cell. No really satisfactory solution has been reached. The leading possibilities are described. They are characterised by a change of the angle between the two independent sets of planes which reflect the two strong equatorial spots from 90°, the value which first suggests itself, to 109·5°. The new choice is shown to be consistent with all the evidence. It has the great advantage of resolving fairly well the familiar discrepancy

V. 19

between measured and calculated values of the density of the crystals in stretched rubber. The new value from the unit cell is 1·00. A necessary consequence of the X-ray data is that the C atoms of a molecular chain are not coplanar in stretched rubber. The reason appears to be the large repulsive forces which would have to exist in that configuration. In rotations on the single bonds during stretching and retraction the inter-atomic forces are probably repulsions in the dominating pairs. Repulsions give a plausible explanation of the form of the outer part of the stress-strain curve. AUTHOR.

1392. X-Ray Adventures among the Proteins. W. T. Astbury. *Faraday Soc., Trans.* 34. *pp.* 378–388, *Feb.*, 1938.—A lecture summary of the work of the author and others on the X-ray analysis of fibre and protein structure. The lecture embraces all those points, *e.g.*, amino acids, stretching of polypeptide chains, supercontraction, folding of molecular structure, etc., that have been the subject of his many researches published elsewhere. It is an excellent review of the present position. S. G. B.

1393. Wave Nature of the Periodic Reaction of Silver Bichromate. V. K. Nikiforov and S. S. Kharamonenko. *Acta Physicochimica*, 8. 1. *pp.* 95–102, 1938. *In English.*—The wave nature of periodic reactions between KI and $Pb(NO_3)_2$ in agar-agar, and between $AgNO_3$ and $K_2Cr_2O_7$ in gelatin has been established by the application of optical analogies. In the first case the ring deposits agree with Huygens' principle, and in the second case with the refraction equation, $n = \sin \alpha_1/\sin \alpha_2 = v_2/v_1$. A. J. M.

See also Abstracts 1424, 1623 and
1159B. Composition and Structure of Hevea Latex. A. R. Kemp.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1394. Calculation of Constants of Sr and Ba. P. Gombás and G. Péter. *Zeits. f. Physik*, 107. 9–10. *pp.* 656–661, 1937.—By means of a statistical method and without employing empirical or semi-empirical parameters the lattice constant, lattice energy, and heat of sublimation of Sr and Ba are calculated. The results agree well with empirical values. R. S. R.

1395. X-Ray Diffraction by Self-Illuminated Crystals. H. Ott. *Ann. d. Physik*, 31. 3. *pp.* 264–288, *Feb.*, 1938.—The diffractions observed by Kossel [see Abstracts 2768 and 3717 (1936)] from single crystal anti-kathodes are explained in terms of wave-mechanical theory. It is shown that the fine-structure of the reflections is characteristically determined by the Fourier-phase of the lattice, and the bearing of these conditions upon structure examination is outlined. A. G. Q.

1396. Theory of Order for the Copper-Gold Alloy System. W. Shockley. *J. Chem. Phys.* 6. *pp.* 130–144, *March*, 1938.—The theory of order and disorder, in the form used by Bragg and Williams, is extended to arbitrary composition of the constituent elements. The work is based upon the nearest neighbour interaction assumption of Bethe and the connection between the Bethe and Bragg-Williams theory is shown. In order to extend the Bragg-Williams theory to compositions other than 25 and 50 atomic %, new definitions of order are developed. The results are presented in terms of phase diagrams and curves showing energy *vs.* temperature, specific heat *vs.* temperature and state order *vs.* temperature. These results are of importance in giving a general picture of the order-disorder transformation for a wide composition range. They are not in detailed accord with experiment due to the rather idealised picture underlying the nearest neighbour assumption. AUTHOR.

1397. X-Ray Examination of System Cr-As. H. Nowotny and O. Årstad. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 461–465, 1938.—The alloys containing 0–50% As were prepared as those of Mn and P [see Abstract 930 (1938)]. The existence of Cr_2As (a 3·613 Å, c 6·333; d 7·04), and CrAs (a 3·479, b 6·210, c 5·730; d 6·81) was definitely established with some indication of Cr_3As_2. Cr_3As_2 and CrAs are isomorphous with Fe_2As and FeAs, and are weakly ferromagnetic. C. A. S.

1398. Grain-Growth of Micro-Crystals in Drawn Al Wire. T. Fujiwara and Y. Umemoto. *Hirosima Journ. Sci.* 8. *pp.* 87–92, *Feb.*, 1938. *In English.*—The manner of growth of the micro-crystals occurring in the cross-section of a drawn wire of Al heated externally was examined by means of X-rays. It was found that when the wire is heated properly, a crystal seed appears in a comparatively outer portion of the wire, grows most prominently along a circumference passing through the position of the crystal seed, and finally forms one single ring-shaped crystal. AUTHORS.

1399. Crystal Chemistry of Non-Metallic Inorganic Substances. F. Machatschki. *Naturwiss.* 26. *pp.* 67–77, *Feb.* 4, *and pp.* 86–92, *Feb.* 11, 1938.—The progress in the X-ray analysis of inorganic substances that has taken place in the ten years 1927–1936 is reviewed. The author gives a short introduction and then discusses the results that have been published in this period on elements and the various classes of inorganic compounds. J. I.

1400. Structure of Germanous Iodide. H. M. Powell and F. M. Brewer. *Chem. Soc., J. pp.* 197–198, *Feb.*, 1938.—A modified method of preparing germanous iodide is described. X-ray investigation shows the crystal structure of the substance to be the C·6 type, and therefore establishes the existence of the germanous ion. The radius of this ion for NaCl type structures is estimated to be 0·98Å. AUTHORS.

1401. Configuration of a Pentahalogen Anion Group from the X-Ray Structure Determination of Potassium Tetrachloriodide Crystals. R. C. L. Mooney. *Zeits. f. Krist.* 98. 5–6. *pp.* 377–393, 1938. *In English.*—The crystal structure of potassium tetrachloriodide is determined by X-rays. The crystal is monoclinic and has the symmetry of C_2^5h ($P2_1/n$). There are 4 molecules in a unit cell of dimensions, $a = 13·09$, $b = 14·18$, $c = 4·2$Å and $\beta = 95°·7$. The calculated density is 2·62 gm./cm.^{3}, compared with an experimental value, 2·7 gm./cm^3. By means of a two-dimensional Fourier analysis, the 18 parameters are determined without any preliminary assumptions as to grouping or expect interatomic distances. The 5 halogens form a complex anion group in which the central I atom forms 4 coplanar bonds extending towards Cl at the corners of a square. The I-Cl bonding distances are 2·34Å, and the average distance between Cl not in the same group is 3·77Å, the minimum being 3·57Å. The K-Cl distance of 3·23Å is large for coordination 6, which is to be expected from the fact that the K ion is at the lower size limit for the formation of a stable lattice with such large anions. C. J. B. C.

1402. Oxygen Parameters in Sodium Periodate. E. A. Hazlewood. *Zeits. f. Krist.* 98. 5–6. *pp.* 439–446, 1938. *In English.*—By means of Laue and oscillation photographs about the a and c axes, with Mo K_α and Cu K_α radiation, the previously determined space-group C_4^6h ($14_1/a$) is confirmed; $a = 5·3222 \pm 0·0004$ by Cohen's precision method,

$c = 11 \cdot 93$ Å. Intensity measurements of 00*h* and *hk*0 reflections are made with a Bragg spectrometer with Geiger-Müller counter, coupled to a two-stage amplifier, and thence to a 6-valve Wynn-Williams thyratron, after the method of Le Galley [see Abstract 775 (1935) and *Rev. Sci. Instruments*, 6. *p*. 279, 1935]. There are 4 I atoms in position *a*, and 4 Na atoms in position *b* ; the O atoms occupy positions *f*, with variable parameters 0·220, 0·159, 0·089. These values are established by comparison of reflections due to O atoms alone, and by comparison of pairs of reflections differing only in respect of O atoms. D. R. H.

1403. Structure of Solid Helium. W. H. Keesom and K. W. Taconis. *K. Onnes Lab. Leiden, Comm. No.* 250*e*. *Physica*, 5. *pp*. 161–169, *March*, 1938. *In English*.—An apparatus is described with which exposures were made of single crystals of solid He at 1·45° K, compressed to 38 atm. in a thin-walled Al tube rotating in a Debye-Scherrer camera. Considering the spacings and the intensities of the reflection spots, and comparing with the expected density of solid He, hexagonal closest packing of He atoms was indicated. This structure is confirmed, using the data which the places of the reflection spots on the pictures furnished. The distance of the two atoms in this packing was found to be 3·57 Å and at 1·45° K. and about 37 atm. a density of 0·205 was calculated. AUTHORS.

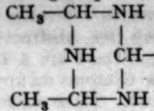
1404. Length of Aliphatic Carbon Bond. C. H. MacGillavry. *Zeits. f. Krist.* 98. 5–6. *pp*. 407–410, 1938.—From a consideration of the intensities of spots on an electron diffraction photograph of paraffin the author obtains the parameters of the C atoms in the basal plane of the unit cell. The value (r) of the lateral displacement of neighbouring atoms in the zig-zag chain molecule is then calculated. Using the known cell dimensions of paraffin, $a = 7 \cdot 2$, $b = 4 \cdot 8$ Å [Motz and Trillat (1935)], $r = 0 \cdot 8$ Å. The dimensions found by Müller [see Abstract 46 (1929)] for $C_{29}H_{60}$, viz., $a = 7 \cdot 45$, $b = 4 \cdot 97$ Å give a value $r = 0 \cdot 82 \pm 0 \cdot 11$ Å. These values of r do not agree with the value 1·4 Å deduced by Müller from his experimental results. Combining the above value of $r = 0 \cdot 82 \pm 0 \cdot 11$ Å with the accepted value 1·27 Å for the vertical distance between alternate C atoms in the chain a value of $1 \cdot 52 \pm 0 \cdot 07$ Å is obtained for the C-C bond distance. J. I.

1405. X-Ray Examination of Single Crystals of Cetyl Palmitate. R. Kohlhaas. *Zeits. f. Krist.* 98. 5–6. *pp*. 418–438, 1938.—Cetyl palmitate is monoclinic with a 5·61, b 7·42 Å, β 61·3°, $c \sin \beta$ 77·875 (which gives $c = 88 \cdot 79$ Å) ; d 0·989 ; 4 mols. in unit cell, which are united two and two into two double molecules, with average distance C-C = 1·27 Å ; space group $C_{2}^{5}h$. There is no trace of any transformation between 20° and the m.p. (54°). Dicetyl ether is very similar with a 5·49, b 7·45 Å, β 63·2°, $c \sin \beta$ 38·97 or 77·94 Å (which gives $c = 43 \cdot 22$ or 86·45), according as there are deemed to be two (double) or four (single) molecules in the unit cell. C. A. S.

1406. Structure of Benzil. K. Banerjee and K. L. Sinha. *Indian Journ. Phys.* 11. *pp*. 409–415, *Jan.*, 1938.—The space group of benzil crystal has been found to be $D^{4}{}_{3}C_{31}{}^{2}$ and $D_{3}{}^{6}C_{32}{}^{2}$ for the two enantiomorphic forms. The molecular plane of each molecule is inclined to the triad axis at 13°, the three molecules are parallel to the three basal axes and are arranged spirally about a three-fold screw-axis. AUTHORS.

1407. Structure of Acetaldehyde-Ammonia ($CH_3 \cdot COH \cdot NH_3$). N. F. Moerman. *Zeits. f. Krist.* 98. 5–6. *pp*. 447–455, 1938.—The rhombohedral crystals of the above substance have 6 mols. ($CH_3 \cdot COH \cdot NH_3$)

per unit cell. The space group is D_{3d}^5. It is shown that the 6 mols. are arranged to form layers of a ring-shaped molecule



the layers being bound together with 6 H_2O mols. for each pair of ring mols. The H_2O mols. are distributed about a centre of symmetry, in the form of a 6-membered ring. The following intermolecular distances are given, $CH_3 - CH_3$ in the direction of the hexagonal axis $= 4 \cdot 1$ Å, in the direction of the rhombohedral [100]-axis $= 3 \cdot 4$ Å, $CH_3 - H_2O = 3 \cdot 4$ Å, $H_2O - H_2O = 3 \cdot 0$ Å, $H_2O - NH = 3 \cdot 4$ Å. J. I.

1408. X-Ray Diffraction Studies on Human Bone. L. Reynolds, H. S. Hayden and K. E. Corrigan. *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 286–287, *Feb.,* 1938.—X-ray diffraction patterns are illustrated for normal and pathological bones. These show differences of structure and such methods of investigation may have future value in respect to the correlation of groups of diseases. B. J. L.

1409. Effect of Temperature on the Atomic Distribution in Liquid Sodium. F. H. Trimble and N. S. Gingrich. *Phys. Rev.* 53. *pp.* 278–281, *Feb.* 15, 1938.—X-ray diffraction patterns of liquid Na at eight temperatures ranging from 100° C. to 400° C. have been obtained with monochromatic Mo Kα radiation. Fourier analyses of the 100° C. and the 400° C. intensity curves were made in order to obtain the atomic distribution functions. The distribution function at 400° C. shows that at this temperature, the first concentration of atoms about any atom occurs at a distance of 3·90 Å and the second concentration of atoms occurs at about 7·2 Å. The peaks in this curve are broader, and the curve approaches the average density more rapidly, than in the 100° C. case. For sodium at 100° C., the distance of closest approach of the atoms is 3·83 Å. AUTHORS.

1410. Fourier Analysis of Liquid Methyl Alcohol. G. G. Harvey. *J. Chem. Phys.* 6. *pp.* 111–114, *March,* 1938.—X-ray diffraction curves for liquid methyl alcohol have been obtained at 25° C. and −75° C. with monochromatic Mo Kα radiation out to $\sin \theta/\lambda = 1 \cdot 2$. At −75° C. there is much greater detail in the diffraction curve than is observable at the higher temperature. Five diffraction rings are visible on the film. Fourier analyses of these intensity curves lead to radial atom distribution functions which are interpreted in terms of Zachariasen's picture of the molecular arrangement in liquid methyl alcohol. The results are distinctly favourable to Zachariasen's picture [see Abstract 1330 (1935)]. AUTHOR.

1411. Crystal Habit and Intermolecular Forces in Homopolar Crystals. I. N. Stranski. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 451–460, 1938.—The author describes a method by which the range of the intermolecular (or interatomic) forces in homopolar crystals can be estimated from the form of such crystals when crystallised from a solution of known supersaturation. The results for Cd crystals are interpreted on the basis of the Clausius-Clapeyron equation. J. I.

***1412. X-Ray Photography of Reciprocal Lattice. W. F. de Jong and J. Bouman.** *Zeits. f. Krist.* 98. 5–6. *pp.* 456–459, 1938.—By rotating a crystal about a vertical axis, and by using a horizontal X-ray beam with a horizontal photographic film placed above the crystal and rotating at the same speed as the crystal, a photograph may be obtained of the projection of points of the reciprocal lattice. A suitable apparatus is described in which a shield, having a circular gap, fixed between the crystal and the film, cuts out all reflections except those corresponding to a desired layer line. [See following Abstract.] J. T.

***1413. X-Ray Photography of Zero-Order Reciprocal Net Planes of a Crystal. W. F. de Jong, J. Bouman and J. J. de Lange.** *Physica*, 5. *pp.* 188–192, *March*, 1938. *In English.*—A method is described for obtaining an image of the zero-order reciprocal net plane without any distortion of the picture. This may be important, as all rays reflected by the crystal travel to the film along paths of equal length. Apart from the fact, that they reach a film at the constant angle, which can be adjusted so as to suit any special demands, the intermediate distances between the reciprocal net points on the photograph can also be varied. These features render the method useful for the comparison of intensities. For research work on fibres it may also be of some use. [See preceding Abstract.] AUTHORS.

1414. Evaluation of X-Ray Reflections from Crystalline Powders. J. C. M. Brentano. *Phys. Soc., Proc.* 50. *pp.* 247–255, *March* 1, 1938.—The conditions determining the quantitative measurement of X-ray reflections by the substitution and by the mixed powder methods are compared with regard to the evaluation of atomic scattering factors. The paper is supplementary to a paper by Brindley and Spiers [see Abstract 238 (1938)]; it contributes particularly to the discussion of particle-size, of extinction, and of differential absorption. A method is indicated for determining the presence of differential absorption and so avoiding errors which may arise from that cause when the mixed-powder method is applied to coarse particles. Techniques are described relating to the substitution and to the mixed-powder methods. Attention is drawn to a technique in which the mixed-powder and substitution methods are used conjointly. AUTHOR.

See also Abstracts 1389, 1490, 1669, 1708, 1758 and
1106B. Surface Structure and Properties of Electrolytic Cr. M. Cymboliste.

DENSITY.

See Abstract 1488.

ELASTICITY AND PLASTICITY.

1415. Equilibrium of Thin Flat Membrane of Compressible Material. J. L. Synge. *Roy. Soc. Canada, Trans.* 31. *Sect.III. pp.* 57–81, *May*, 1937.—A fresh development is presented of the author's theory of the equilibrium of a compressible membrane, previously applied to the periodontal membrane [see Abstract 2367 (1937)]. Only the case of a flat membrane is considered, the treatment of the problem including the cases of finite compressibility, small compressibility, very small compressibility and essential incompressibility. The case of a membrane between parallel planes is also discussed. J. T.

1416. Equilibrium of a Thin Plate, Symmetrically Loaded, Resting on an Elastic Foundation of Infinite Depth. A. H. A. Hogg. *Phil. Mag.* 25. *pp.* 576–582, *March*, 1938.—The problem considered is that of a symmetrically loaded thin plate of infinite size, resting on the plane surface of a semi-infinite elastic solid. Expressions are obtained for the curvature and normal displacement of the plate with the load concentrated at a point, and for the curvature at the centre of a circular area over which the load is uniformly distributed. The problem is of some interest in connection with the design of concrete road slabs, and its investigation was undertaken as part of the writer's work at the Road Research Laboratory. A similar problem has been investigated by H. M. Westergaard, but on the assumption that the normal displacement of the surface of the foundation at any point is proportional to the normal pressure at that point. AUTHOR.

1417. Spiral Springs with a Small Number of Turns. R. P. Kroon and C. C. Davenport. *Frank. Inst., J.* 225. *pp.* 171–195, *Feb.*, 1938.—In some cases it is necessary to have springs of such stiffness as can only be obtained with comparatively thick cross-section and a few turns. The theory of such a spring is given and it is limited by one extremity of the coil being rigidly fixed, while the other end is free to move on a circle concentric with the geometric centre of the spring. The short spring is not subject to pure bending, and it is seen that the curve of stress concentration to number of turns of coil, shows decided maxima and minima; also, since the windings tend to approach each other at certain points, it is valuable to determine the permissible gap between the coils. The paper contains numerous graphs to evaluate the constants and numerical examples to illustrate the points. There are four appendices for the evaluation of integrals, the estimation of errors and so forth. H. M. B.

1418. Determination of Elastic Constants. F. Khol. *Zeits. f. Physik,* 108. 3–4. *pp.* 225–231, 1938.—The elastic constants, modulus of elasticity E and Poisson's ratio σ, are obtained from the characteristic radial oscillations of circular plates. The theory is developed from a formula of Love and by obtaining the ratios of the wave-lengths of the first two overtones to the fundamental, the constants can be calculated using Table I of the paper. Results are obtained for small plates of tourmaline and of quartz excited piezoelectrically and for Ni excited by magnetostriction. For Ni, the temperature coefficient of the constants, between 20° and 150° C. are obtained using a thermo-element to measure the temperature. Comparison is made with earlier results to show the degree of agreement. If a rectangular plate is made to oscillate longitudinally, rather a large discrepancy is seen between these results and those of a circular plate, but this is accounted for, since theoretically one edge of the plate should be infinite. H. M. B.

1419. Elastic Properties of Metallic Wires at High Temperature. T. Fujiwara and T. Hukuda. *Hirosima Journ. Sci.* 8. *pp.* 93–98, *Feb.*, 1938. *In English.*—A method of observation of the elastic properties of fine metallic wire at a high temperature is described. The wire to be tested, mounted vertically, is heated by passing a current through it at a certain required temperature *in vacuo*, and is bent to a suitable extent by applying a magnetic force to it. By measuring the current passed through the wire, the deflection of the wire, and the magnetic force, the elastic modulus of the specimen at the required temperature is determined. AUTHORS.

1420. Theory of Crystal Plasticity. A. Kochendörfer. *Zeits. f. Physik,* 108. 3–4. *pp.* 244–264, 1938.—A theory of plasticity is outlined, which is based on conceptions previously put forward by the author and by Taylor, Orowan and W. G. and J. M. Burgers. The results obtained experimentally for the variation of strength with temperature and with velocity of slip agree well with those predicted by the theory. [See also Abstract 4331 (1937).] J. T.

1421. Equilibrium of Plane Parallel Layers in Plastic Media at the Flow Limit. J. Mandel. *Comptes Rendus,* 206. *pp.* 317–318, *Jan.* 31, 1938.—The equilibrium conditions for plastic materials are discussed mathematically, and the characteristic marginal lines are derived both for the presence and absence of mass forces. Application is then made to earths and ductile metals. H. H. Ho.

1422. Relation between Elastic and Optical After-Effects. H. Mussmann. *Ann. d. Physik,* 31. 2. *pp.* 121–144, *Jan.,* 1938.—Experiments are described on glass and celluloid dealing with the relation between the elastic after-effect, the time, and the applied load. The experimental results show that the stress acting is proportional to the elastic after-effect and that the strain constituent is proportional to the log. of the time. For celluloid the after-effect phenomena increase with temperature almost up to the softening point. An empirical law is given for the relation between the elastic and optical behaviour of celluloid under stress. A theoretical explanation is advanced on the basis of Prandtl's model and the derived formulæ are found, in general, to agree satisfactorily with the experimental results. R. L.

1423. Velocity of Elastic Vibrations in Small Specimens. A. E. Ostrovskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 7. *pp.* 357–360, 1937. *In English.*—In geological prospecting by seismic methods it is necessary to know the velocity of elastic waves in rocks and various minerals at various temperatures, pressures, etc. Hitherto this has been done indirectly by recording the propagation of an explosive impulse over a long base line. The author now describes a method by which the velocity is measured in relatively small specimens *e.g.,* in rocks from drill holes. Two electro-mechanical receivers are attached to the specimen at a known distance apart and the time of traverse of the wave is measured by a specially designed valve-ballistic galvanometer circuit. The accuracy of the method was checked by measuring the velocity of a longitudinal wave in an iron bar (5180 m./sec.) and in air (330 m./sec.). A. B. W.

1424. Form Assumed by a Steadily Rotating Thread. H. W. Hall and W. Hunter. *Phil. Mag.* 25. *pp.* 193–234, *Feb.,* 1938.—The results are recorded of investigations undertaken to find the cause of the anomalies in the behaviour of the tension in a thread wound from a fixed bobbin. The treatment is mathematical throughout. If the thread from the bobbin is passed through an eyelet fixed on the axis of the bobbin and then carried off at a given rate, the motion round the bobbin of the point at which the thread leaves as it unwinds causes rotation of the portion of the thread between the bobbin and the eyelet. For certain distances of the eyelet from the point where the thread leaves the bobbin abrupt changes occur in the form of the rotating thread, with accompanying changes in the tension of the thread beyond the eyelet. The paper investigates mathematically the incidence of these changes. The method is first to obtain a complete solution of the equations of motion of a steadily rotating thread in terms of elliptic functions and then to obtain the relations between the dimensions of the system for which change of form can occur. Finally these relations are presented in graphical form and the theoretical results shown to be in good agreement with practical issues.

From the results it is probable that the theoretical form for the thread found by ignoring the effect of air resistance can serve as a guide to the range where instability is to be expected, and in particular gives a good approximation to the lower limit of this range. S. G. B.

1425. Frequency of Longitudinal and Torsional Vibrations of Unloaded and Loaded Bars. R. M. Davies. *Phil. Mag.* 25. *pp.* 364–386, *Feb.*, 1938.—The formulæ of longitudinal vibrations by Rayleigh and others for an infinitely thin loaded fixed-free bar are investigated and the limits of accuracy of the approximations of the frequencies of the oscillations computed for varying ratios of mass of load to mass of bar. This is then extended to bars of finite lateral dimensions, and ratios of pulsatance of longitudinal vibrations with lateral motion to those without lateral motion is given. A close analogy is seen to exist between longitudinal and torsional vibrations of bars, and for infinitely thin bars the equations of the first section of the paper can be used except that mass is replaced by moment of inertia. When the bar has finite lateral dimensions, the equations need considerable modification, which is fully worked out. H. M. B.

See also Abstracts 1391, 1450, 1462, 1562, 1609 and
1113B. Stress Strain Curve for Polycrystalline Metals. R. K. Haskell.

HYDRODYNAMICS AND AERODYNAMICS.

1426. Comparison of the Method of Variables (ϕ, ψ_1, ψ_2, t) and the Method of Eulerian and Lagrangian Variables. D. Riabouchinsky. *Comptes Rendus,* 206. *pp.* 295–297, *Jan.* 31, 1938.—A hydrodynamical theory based upon two flow functions derived by integrating the equations of lines of fluid flow, and a potential function of generalised velocities is briefly discussed, and contrasted with the Eulerian and Lagrangian theories. [See following Abstract.] J. S. G. T.

1427. Approximate Equations of Motion in Three Dimensions of a Perfect Compressible Fluid. D. Riabouchinsky. *Comptes Rendus,* 206. *pp.* 472–475, *Feb.* 14, 1938.—The theory developed [see preceding Abstract] is extended to discuss the three dimensional, subsonic, sonic, or supersonic motion of a perfect, compressible fluid. The two-dimensional theory of conjugate functions of complex variables is extended to 3 dimensions. J. S. G. T.

1428. Theory of One-Dimensional Unsteady Fluid Flow in Pipes. I. A. Čarnyi. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 1. *pp.* 11–16, 1938. *In German.*—The exact equation is simplified by neglecting the convection terms in the acceleration, and by linearising the term involving v^2 ($v =$ fluid velocity) by replacing it by $v_o v$ ($v_o =$ average value of v). The equation then becomes formally similar to one met with in electrical transmission problems, and is dealt with by methods already used for this problem. W. G. B.

1429. Hydrodynamical Theory of Lattices, and Certain Boundary Problems, which Lead to Periodic Functions of a Complex Variable. L. Sedov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 1. *pp.* 17–20, 1938. *In German.*—A general formula for the complex potential due to a uniform stream at infinity flowing past a series of infinite sets of equidistant parallel plates is constructed, circulation (equal about all members of any one set) being included. Certain special cases, especially that of only one set, are considered, and it is mentioned that the case of a single plate in a channel is included in the general formula. W. G. B.

1430. Solution of the Laminar Boundary Layer Equations. L. Howarth. *Roy. Soc., Proc.* 164*A*. *pp.* 547–579, *Feb.* 15, 1938.—The problem of the flow along a flat plate placed edgewise to a steady stream, when a retarding pressure gradient varying linearly as the distance x from the leading edge of the plate is superposed is discussed. If y denotes distance measured perpendicular to the plate, a solution is obtained in the form of a power series in x where coefficients are functions of $y/x^{\frac{1}{2}}$. Differential equations are obtained for these coefficients. Seven of the coefficients have been obtained with reasonable accuracy, and the eighth and ninth roughly. Unfortunately it appears that about eight more terms are required to carry the solution to the point of separation; the work involved in their determination is prohibitive. Two approximate methods have been developed for determining the error when the first seven terms of the series are used as an approximation. These methods lead to the determination of the point of separation and are in agreement as to its position. If b_0 is the velocity at the edge of the boundary layer at the leading edge of the plate and b_1 is the velocity gradient, separation is found when $b_1x/b_0 = 0 \cdot 120$. A method is developed for the solution of the boundary layer equations in any retarded region. It is obtained by replacing the velocity distribution at the edge of the boundary layer by a circumscribing polygon of infinitesimal sides and applying the preceding solution to each of these sides, making the momentum integral continuous at each vortex. The problem is thereby reduced to the solution of a first order differential equation. AUTHOR.

1431. Boundary Layer Calculations. L. Prandtl. *Zeits. f. angew. Math. u. Mechanik*, 18. *pp.* 77–82, *Feb.*, 1938.—The properties of the equations for the two-dimensional steady flow of a viscous incompressible fluid in a boundary layer are discussed, and a method of step-by-step calculation suggested. If the velocity u is expanded in a series $u = a_1y + a_2y^2/2! + \ldots + a_ky^k/k! + \ldots$, where $a_1, \ldots, a_k, \ldots$ are functions of x, it is found by substitution in the equation of motion that a_1 is indeterminate, $a_2, a_3, a_5, a_6, a_8, a_9, \ldots$ are determined from the pressure gradient and from a_1 and from their derivatives, while $a_4 = a_1 \, a'_1/\nu$, $a_7 = (4 \, a^2_1 \, a''_1 - a_1 \, a'^2_1)/\nu^2$, where the dash denotes differentiation with respect to x. Hence if we start by finding a_1, a_4, a_7 at an initial section from the values of u at three fixed values of y, the equations give the values of a'_1, a''_1, and hence also a'_4. (The coefficients $a_2, a_3, a_5, a_6, \ldots$ are determined from the conditions for the absence of singularities.) Hence values are found for a_1, a_4 at a section farther downstream. The process, which does not furnish a value for a'_7, must be combined with step-by-step calculations by another process at some distance from the solid boundary. The further process suggested depends on the use of the equation, first published by v. Mises, in which the total head is the independent variable, and x and the stream-function the dependent variables. S. G.

1432. Distribution of Velocity in Turbulent Flow. J. J. Sommer. *Phys. Zeits.* 39. *pp.* 110–127, *Feb.* 1, 1938.—This paper contains an attempt to use the ideas of the kinetic theory of gases to describe turbulent flow. The vortex-filaments are replaced by " point-vortices," between any two of which a force of the form $(k_1 + k_2 e^{-at})/r^2$ is supposed to act. S. G.

1433. Experimental Determination of the Spectrum of Turbulence. L. F. G. Simmons and C. Salter. *Roy. Soc., Proc.* 165*A*. *pp.* 73–87, *March* 18, 1938.—The time variation of velocity at a fixed point in a turbulent air stream is analysed into a spectrum. The method adopted involves the use of the ordinary hot-wire technique to produce changes of potential in a Wheatstone bridge circuit, which are magnified by a valve amplifier. The fluctuating voltage drop generated across a resistance in the output circuit of the amplifier is then applied, in turn, to electrical filters having different cut-off frequencies. In each case the output current is measured, with and without each filter in circuit, by means of a thermal milliammeter which indicates the mean value of the square of the current supplied to it. From the ratios of the readings taken with and without each filter, the spectrum curve is calculated by a method described by **G. I. Taylor** in the Appendix [*ibid. pp.* 87–89]. All measurements were made in a wind tunnel, at a point in the air stream where the turbulence created by a grid of regular mesh was known to be isotropic: the wind speeds used were 15, 20, 25, 30 and 35 ft./sec.
AUTHORS.

1434. Equilibrium of a Vortex Maintained in a Sudden Expanding Stream. A. Miyadzu. *Phil. Mag.* 25. *pp.* 567–576, *March*, 1938. —In a previous paper [see Abstract 1412 (1935)] the author has discussed mathematically the positions of equilibrium of a vortex maintained in a suddenly expanding stream; these positions are given by two curves starting respectively at a concave and convex corner and extending to infinity. In the actual flow, however, there appears a single or a single principal vortex at a definite position in the channel. This discrepancy is the result, principally, of a deficiency in the mathematical treatment; the present treatment decides uniquely the position of equilibrium as determined by the actual condition of flow. J. S. G. T.

1435. Experimental Investigations of the Hydrodynamics of a Sphere. W. Möller. *Phys. Zeits.* 39. *pp.* 57–80, *Jan.* 15, 1938.—A report is given, with illustrations, of photographic and kinematographic investigations of flow in the wake of a sphere at Reynolds numbers between 150 and 10000. The Reynolds number, R, at which unsteady flow commences, the forms of the flow in the steady regime, in the unsteady regime, and during the transition, and the influence of the constraint of the walls of the vessel containing the fluid, are discussed. Attempts are made by various methods to estimate the vortex frequency in the unsteady regime. The second part of the paper reports investigations by dropping tests of the drag of a sphere at very small Reynolds numbers. The influence of the walls (and therefore the correction to be applied) is kept as small as possible, and in order as far as possible to cancel any error in the measurement of the viscosity $d(\psi R)/dR$ is compared with experiment, where ψ is the drag coefficient. This differential coefficient is zero on Stokes' theory and 4·5 on Oseen's theory. For $R < 0\cdot 6$ the experimental results agree considerably better with Oseen's theory than with that of Stokes. S. G.

1436. Inclined Liquid Jet. J. Satterly and G. W. C. Tait. *Roy. Soc. Canada, Trans.* 31. *Sect. III. pp.* 119–130, *May*, 1937.—Levi-Civita calculated that an inclined jet of liquid would not follow a parabolic path but in its upward portion would have a profile similar to that of an inverted catenary. This was tested a year ago by Satterly and Levitt [see Abstract 70 (1937)]. Taking an origin at the summit of the profile, the axis of x

horizontally in the forward direction and the axis of y vertically upwards the equation of the parabola may be written $y = -\frac{1}{2}kx^2$ and that of the inverted catenary as $y = -(1/k)(\cosh kx - 1)$ where $k = g/c^2$, where g is the acceleration of gravity and c the velocity of the liquid at the summit of the profile. Another proposed equation for the upward portion of the jet is $\epsilon^{ky} = \cos kx$ or $y = (1/k)\log\cos kx$, where k has the same meaning as before. For the same value of c the three curves have the same curvature at the summit and therefore agree closely near that point. Satterly and Levitt photographed the jet and made measurements to see which of the first two equations was more nearly correct. In the present paper the velocities of different portions of a water jet have been measured by mixing a suitable powder with the water before it reached the jet, sending an intermittent beam of light along the jet and photographing the trails thus produced. The measurements show that the velocity along the jet is not constant (the hypothesis upon which the third equation is based) but that the horizontal components of the velocities are practically equal, thus confirming the parabolic *régime*, at least for the first half of the jet. The second half will be studied in the future. AUTHORS.

1437. Analogous Realisations of Flow with Discharge Lines. J. Pérès and L. Malavard. *Comptes Rendus*, 206. *pp.* 418–420, *Feb.* 7, 1938.—An electrical method for deriving lines of flow is illustrated by considering plane flow in front of and in the wake of a normal plane obstacle. J. S. G. T.

See also Abstracts 1461, 1497, 1541, 1543 and 1100B. Gradient Diagram. H. W. Gardner.

KINETIC THEORY OF MATTER.

***1438. Experimental Investigation of Thermo-Molecular Pressure Difference. S. Weber, W. H. Keesom and G. Schmidt.** *K. Onnes Lab. Leiden, Comm. No.* 246*a*. [16 *pp.*], 1938. *In German.*—In this paper new experiments on the thermo-molecular pressure difference [see Abstract 261 (1934)] are described for He at He temperatures, and also new determinations for He, Ne, H_2, and other gasses at O_2 and H_2 temperatures. The results are compared with the theory [see Abstract 262 (1934)] and the constants k_1, k_2 are determined. For He $k_1 = 1{\cdot}36$, $k_2 = 1{\cdot}68$, and $\mu = 1{\cdot}25$. Practically the same values were found for the other gases investigated so that now it is possible to calculate the thermo-molecular pressure difference for all these gases which is necessary for gas thermometry and for many low temperature experiments. In the course of the work a special manometer was developed which is stated to enable readings to be taken to $0{\cdot}2\ \mu$ Hg. The theory is compared with the work of Knudsen, and the results are given both in graphical and tabular form. [See following Abstract.] E. H. D.

1439. Comparison of Results with Theory. S. Weber. *K. Onnes Lab., Leiden, Comm. No.* 246*b*. [10 *pp.*], 1938. *In German.*—The conditions at the surface of a solid are considered, in particular the work of Maxwell is mentioned, and his formula given for the slip velocity at a surface having a tangential temperature gradient. Modifications of the equation are given and finally the thermo-molecular pressure difference form is developed. Later the boundary conditions are applied to a small element in a circular tube, having a longitudinal temperature gradient, and the thermo-molecular pressure difference formula is thus derived. The findings of a number of other workers are discussed. [See preceding and following Abstracts.] E. H. D.

1440. Experiments on the Thermo-Molecular Pressure Difference in the Region of the Boundary Condition $p_1/p_2 = \sqrt{T_1/T_2}$. S. Weber and G. Schmidt. *K. Onnes Lab., Leiden, Comm. No.* 246*c*. [13 *pp.*], 1938. *In German.*—The constant μ which occurs in the formula for the thermo-molecular pressure difference cannot be a constant in the whole range $0 \leqq R/\lambda \leqq a$; in the neighbourhood of the value $R/\lambda \rightarrow 0$ the formula must approach the square root form $p_1/p_2 = \sqrt{T_1/T_2}$. In this connection it is to be noted that the formula for μ is of the type $\mu = \dfrac{1 + gR/\lambda}{1 + hR/\lambda}$; further $\mu_\infty = g/h = 1{\cdot}25$. In order to trace the variation of μ it was necessary to put in hand a series of experiments which needed work at quite low pressures. Many difficulties were encountered but were overcome. The apparatus is illustrated and described. A hot wire manometer was immersed in liquid O_2 while a larger container supplying the gas to the tube was immersed in ice. The capillary tube was covered throughout its length with tinfoil in order to maintain a uniform temperature gradient. Results are given for He, H_2, and they are compared with theoretical values and show good agreement. The formula is then extended to other gases. [See preceding and following Abstracts.] E. H. D.

1441. Equilibrium Conditions in Gases. S. Weber. *K. Onnes Lab., Leiden, Comm. No.* 246*d*. [7 *pp.*], 1938. *In German.*—When a mass of gas is contained in two communicating vessels the equilibrium condition is that the pressure shall be the same at all points in the gas, and formerly this was said to hold even if the two vessels were at different temperatures, and if there was a temperature difference along the communicating tubes. If R is the radius of the connecting tube and λ the mean free path of the gas molecules we know that the above condition only holds if $\lambda/R \overset{\rightarrow}{=} 0$ when the temperatures of the two vessels are different. When $\lambda/R \overset{\rightarrow}{=} \infty$ for both vessels then the equilibrium condition is that $p_1/p_2 = \sqrt{T_1/T_2}$, p_1 and p_2 and T_1 and T_2 being respectively the pressures and temperatures of the vessels. When the He thermometer is used for low temperature measurements it is approximately true that $\lambda_1/R \overset{\rightarrow}{=} \infty$ for the reservoir at the high temperature, but $\lambda_2/R \overset{\rightarrow}{=} 0$ for the reservoir in the He bath. In this case, starting from the formula for the thermo-molecular pressure difference the equilibrium condition $(p_2/p_1)^{1+2n} = (kR/{}_1\lambda_0)(273{\cdot}1/T_1)^{\mu n}\, p_1$ is obtained, where k is a numerical factor, and ${}_1\lambda_0 = (p\lambda)_{T=273\cdot1^\circ K} = (\sqrt{\pi/2})\eta_0/\sqrt{{}_1\rho_0}$ η_0 is the viscosity of the gas at 0° C., whilst n is obtained from the formula $\eta/\eta_0 = (T/T_0)^{\frac{1}{2}+n}$ for the variation of viscosity with temperature; ${}_1\rho_0$ is the density of the gas at 0° C., and a pressure of 1 microbar. If $n = 0$ or is very small (for He $n = 0{\cdot}147$) and $T_1 = 273{\cdot}1^\circ$ K. we have $p_2 = kRp_1^2/{}_1\lambda_0$ or $p_2 = \text{const.}\ p_1^2$ for the measurement of very low temperatures, with whatever gas the thermometer is filled. [See preceding Abstract.] E. H. D.

1442. Kinetic Theory of Monatomic Liquids. A. Harasima. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 120–124, *Feb.*, 1938. *In English.*—A simple model for monatomic liquids is proposed. By this model it is shown that the specific heats of monatomic liquids obey Dulong and Petit's law, and that the thermal pressure calculated kinetic-theoretically agrees well with that calculated thermodynamically. AUTHOR.

1443. Scattering of Tl and Cd Atomic Rays at Oil Surfaces. G. Vészi. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 424–426, 1938.—Tl and Cd atomic rays reflected at a rotating oil surface gave diffraction rings. They are due to diffraction of the atoms at disordered molecules of the oil surface. An optical analogy is suggested. A. J. M.

1444. Distribution of Water Vapour Issuing from a Capillary Tube. P. Renaud and G. Costeanu. *Comptes Rendus,* 206. *pp.* 500–502, *Feb.* 14, 1938.—Water vapour is projected from a capillary tube of 0·5 mm. dia. into a well evacuated glass vessel cooled opposite the capillary by liquid air. Rings of ice of varying thickness appear opposite the opening of the capillary, the number of rings increasing with time and varying with the length of the tube and the pressure. Change of pressure hardly affects the distribution but alters the intensity, but altering the length of the tube has the opposite effect. A tube 8 cm. long gives a practically uniform distribution in an open cone, one of 3 cm. is the best for obtaining molecular rays. When the vacuum near the mouth of the capillary is good, the experimental rays are not found to correspond with the theoretical molecular waves of de Broglie. H. M. B.

See also Abstracts 1432, 1704.

LENGTH, AREA AND VOLUME.

***1445. Mechanical Amplification of Small Displacements. A. F. C. Pollard.** *Journ. Sci. Instruments,* 15. *pp.* 37–55, *Feb.,* 1938.—Describes a number of the more satisfactory methods of amplifying small displacements and of accurately reducing large movements to small and corresponding displacements. The mechanisms described and discussed include levers, combined with optical means of increasing their sensitivity, the rolling cylinder of small diameter, gear trains of various types, the differential screw mechanism, the wedge and cone mechanisms, mechanisms depending on the bending, twisting or sagging of flexible elements, hydraulic and liquid indicating devices, including spirit levels, and a pneumatic micrometer. The paper concludes with a discussion of the natural limit to the sensitivity of all measuring instruments, and a short Bibliography. J. S. C.

***1446. Zeiss Invar Levelling Rods. H. Peschel.** *Zeits. f. Instrumentenk.* 58. *pp.* 62–77, *Feb.,* 1938.—The results of a long series of tests on these rods are described. It is concluded that (1) the influence of air temperature is so small as to be negligible, (2) an improvement of 0·013 mm. can be obtained with horizontal measurement, (3) twice-yearly tests should be made to allow for rough handling but no conclusions can be drawn regarding secular change, and (4) this rod is best when used as a comparable standard. R. S. R.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1447. Log π and Other Basic Constants. H. S. Uhler. *Nat. Acad. Sci., Proc.* 24. *pp.* 23–30, *Jan.,* 1938.—The author has found in the course of calculating tables of reciprocals of factorials, that Stirling's asymptotic approximation for log $\Gamma(n)$ is best adapted to the calculation of isolated values of $n!$ to a large number of significant figures. Stirling's formula however, involves a term $\frac{1}{2}\log_{10}2\pi$. In order to obtain it the author has calculated and now publishes the values of $\log_e\pi$ and $\log_{10}\pi$

to nearly 215 decimal places. In addition the logarithms to base 10 o 2, 3, 5, 7, 17, 71 and 113 are given, as well as those to base e of 17, 71, 113. The value of $\frac{1}{2}\log_{10}2\pi$ to 215 places is given as well as those of $1/\pi$ and π^2. The author describes in detail his methods of calculation and the checks adopted. G. C. McV.

1448. Analysis of Oscillations. F. Vercelli. *Ricerca Scientifica,* 8. *pp.* 609–621, *Dec.,* 1937.—Some examples from different branches of physics involving oscillations are analysed by a simple method of calculation. W. A. R.

1449. New Operational Method in Mathematical Physics. T. Sakurai. *Tohoku Math. J.* 44. *pp.* 39–80, *Dec.,* 1937. *In English.*—A mathematical paper the chief object of which is to explain how by a new method boundary value problems in three dimensions can be solved by a purely operational process. J. J. S.

1450. Matrix-Operational Methods in Mechanical Vibrations. L. A. Pipes. *Frank. Inst. J.* 225. *pp.* 343–349, *March,* 1938.—A general method for the solution of mechanical vibration problems in systems of several degrees of freedom is described. The method can be applied in the case of freely vibrating systems or systems in forced vibration. J. J. S.

1451. Operational Representation of M-Functions of the Confluent Hypergeometric Type. S. C. Dhar. *Phil. Mag.* 25. *pp.* 416–425, *March,* 1938.—[See also Abstract 3026 (1936).]

1452. Whittaker's Confluent Hypergeometric Function. J. L. Sharma. *Phil. Mag.* 25. *pp.* 491–504, *March,* 1938.

1453. Integral Representations for Products of Weber's Parabolic Cylinder Functions. W. T. Howell. *Phil. Mag.* 25. *pp.* 456–458, *March,* 1938.

1454. Fractional Differentials. A. Gemant. *Phil. Mag.* 25. *pp.* 540–549, *March,* 1938.—The purpose of the paper is to illustrate the characteristic behaviour of fractional differential quotients. After a short introduction into their computation, whenever the functions involved can be expanded into power series, the fractional, especially half-differential quotients of the exponential, circular, hyperbolic, and Bessel functions, are given by means of graphical representation. The application of the conception to physical problems is shown in two special cases. AUTHOR.

1455. Correction of Frequencies for a Known Standard Error of Observation. H. Jeffreys. *Roy. Astron. Soc., M.N.* 98. *pp.* 190–194, *Jan.,* 1938.—A method given by Eddington [*ibid.* 73. *pp.* 359–360, 1913] for the correction of frequencies for a known uncertainty of observation will in practice increase the random error of sampling, and this effect will often be greater than the improvement given by the allowance for observational error, particularly when the standard error of observation is small compared with the grouping interval. It appears that this will account for the difficulties that have been found in the application of the method. A better way is to begin by applying one of the usual methods of fitting distributions of chance to the observed frequencies and, if necessary, to apply Eddington's method only after the random error has been reduced in this way. AUTHOR.

1456. Statistical Analysis of the Rhythm of Latent Regularities in Depths. K. Brodovitskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 2. *pp.* 85–87, 1938. *In French.*—The author takes the analogy of an aerial messenger between two stations, following always the same route but, in it, is subject to accelerations and delays, though without damage, so that the journeys repeat themselves in a rhythm which he terms the latent regularity of the depth (inobservable); the actual times taken also exhibit a rhythm which may be superficially observed. He distinguishes two ideal cases: (1) of an intermediate period ($\Sigma_s = 0$) in which no perturbation is experienced and the depth rhythm is not hidden; (2) where the intermediate rhythm is exact ($\Sigma_v = 0$); and he says it is possible to estimate these two values although they cannot be observed directly. He applies them to the maximum phase of sunspots (1615–1928) and to the minimum phase (1610–1933). A. S. D. M.

See also Abstracts 1430, 1457, 1498 and
1199B. Integrating Instruments. W. Meyer zur Capellen.

MECHANICS, CLASSICAL.

1457. Inverse Problem of Potential. P. Novikoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 165–168, 1938. *In French.*—The sufficient conditions are determined for the distribution of the mass when W (x, y, z) is the external potential of an unknown mass, *i.e.*, the inverse problem of the potential. The conditions now found are contained in the statement of the following theorem: Let μ (x, y, z) be a function defined at every point in the space xyz, such that min. $\mu > 0$ and that the total variation of μ along an arbitrary straight line does not exceed min. μ; and let b_1 and b_2 be two regions having a common internal point and filled with masses M_1 and M_2 of density μ (x, y, z). If the masses M_1 and M_2 have the same external potential, then the regions b_1 and b_2 coincide. H. H. Ho.

1458. Definition of Stability-Probability. V. Stepanoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 151–154, 1938. *In German.*—The probability that the perturbed motion of a dynamical system in the neighbourhood of a stable motion shall continue to be stable is defined. G. C. McV.

1459. Stable Dynamical Systems in the Sense of Liapounoff. M. Beboutoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 155–158, 1938. *In French.*—It is proved that, under certain supplementary conditions, a dynamical system which is stable in Liapounoff's sense has trajectories which are all either nearly-periodic or homomorphic to a set of parallel straight lines. G. C. McV.

1460. Stability of Motion in First Approximation. I. Malkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 159–162, 1938. *In German.*—The stability of a perturbed motion given by equations of the form $dx_s/dt = \sum_{r=1}^{n} p_{sr}(t)x_r + L_s(t, x \ldots x_n)$, $(s = 1, \ldots n)$, where L_s is the perturbation function, is discussed. G. C. McV.

1461. Gyroscopic Movement of Projectiles. R. d'Adhémar. *Ann. Soc. Sci. de Bruxelles,* 57. *pp.* 73–91, *June* 7, *and pp.* 173–212, *Dec.* 31, 1937.—The numerical data used are stated and an elementary theory is given of gyroscopic motion and the circle of pre-stabilisation. The following further points are treated: the position of periods of virtual instability, the nature of approximation in Mayevsky's equations, the second component of instantaneous rotation, the second moment and Magnus effect, the respective rôle of the two moments, the sense of orientation and the definition of error, the real and apparent singularities and state of virtual instability for zero error, perturbations, the component of instantaneous rotation, and the state of virtual instability corresponding to the minimum error almost zero. Criticisms are made of the incompleteness of the Mayevsky theory and the use of it by Burzio and Popoff. R.S.R.

1462. Velocity of Rebound and Energy Absorbed in Impact of a Hard Striker on a Soft Metal. L. Rebuffé. *Comptes Rendus,* 206. *pp.* 483–485, *Feb.* 14, 1938.—The coefficient of restitution $\epsilon = V_2/V_1$ is plotted against V_1 for the impact of hard strikers against soft metals. V_1 lies between 0·25 m. and 6 m./sec., V_1 being determined photographically. The plots of $V_2(V_1 + V_2)^{-1}[= \epsilon(1 + \epsilon)^{-1}]$against V_2^{-1} are coincident over the whole range, provided m/r is sufficiently large. As V_1 increases indefinitely, ϵ tends to a limit ϵ_0, independent of the radius and mass of the striker, and characteristic of the soft metal. If elastic deformation of the latter is negligible, the energy absorbed is used up entirely in cold-work. If u be the volume of the impact, assumed spherical, $2u/m(V_1^2 - V_2^2)$ also tends to a limit $1/A_0$, independent of the radius of curvature and of the mass of the striker; *i.e.*, characteristic of the metal tested. The following values are obtained, respectively, for ϵ_0 and A_0 (in kg./mm^2.) for different soft metals, polished commercial lead 0·282 and 15, after annealing 0·139 and 8·75; pure tin polished and annealed 0·228 and 35·1; electrolytic copper, polished and annealed 0·270 and 31. [See Abstract 851 (1937).]
D. R. H.

See also Abstract 1450.

MECHANICS, QUANTUM.

1463. Wave-Mechanical Problems as Boundary-Value Problems in Integral Equation Theory. J. W. Smith. *Tohoku Math. J.* 44. *pp.* 178–203, *Dec.,* 1937. *In English.*—This paper deals with the formulation of wave-mechanical problems as integral equations. The integral equation equivalent to the differential system is considered under the headings of the Green function, the finite and infinite intervals, differential systems of limit-circle and limit-point type, and regular and singular integral equations. The formulation of the following well-known problems as integral equations is then developed: the motion of a particle in a homogeneous field, central force problems in one dimension, justification of the boundary conditions, and central force problems in three dimensions.
N. M. B.

1464. Expression of Physical Magnitudes as Functions of New Magnitudes Related to a "Sub-Space." J. Roubaud-Valette. *Comptes Rendus,* 206. *pp.* 495–497, *Feb.* 14, 1938.—A purely mathematical development of considerations previously reported [see Abstract 468 (1938)].
N. M. B.

1465. New Physical Space. H. Ostertag. *Zeits. f. Physik,* 108. 3–4. *pp.* 200–203, 1938.—The author claims to be able to calculate the "constants of nature" on the basis of an algebra of hyper-complex numbers developed elsewhere [see Abstract 3918 (1937)]. G. C. McV.

1466. Van der Waals Forces Between Symmetrical Rotators. K. G. Carroll. *Phys. Rev.* 53. *pp.* 310–312, *Feb.* 15, 1938.—Work of F. London [see Abstract 35 (1931)] on the van der Waals forces between linear dipole molecules has been extended to polyatomic molecules which are representable as symmetrical tops. The results obtained by a second-order perturbation calculation are compared with those of a variational calculation for the specific case of the interaction between two tops in one-quantum states. AUTHOR.

1467. Van der Waals Forces in Helium. C. H. Page. *Phys. Rev.* 53. *pp.* 426–430, *March* 1, 1938.—A variational method of calculating perturbation energy has been applied to the first two terms of a rapidly converging series expansion of the mutual potential energy of two He atoms. The result is compared with the much simpler second-order perturbation scheme of Margenau, which it tends to support. The same variational method was then used with the perturbing potential in closed form. This involves the calculation of integrals not previously evaluated. The result validates the previous expansion of the potential. The author obtains for the van der Waals interaction of two unexcited He atoms:

$$\epsilon = -(A/R^6)\{1 + 6\cdot26/R^2 + 51\cdot2/R^4 + \ldots\}\ \text{ergs},$$

where R is the atomic separation with the first Bohr radius (0·5282 Å) as unit distance. The complexity of the integrations requires the use of simple exponential wave functions of the Hartree type; the resulting value of the coefficient A is therefore poor, but this coefficient is well known from other work. It yields a polarisation molecule with a dissociation energy of $0\cdot30 \times 10^{-16}$ erg. The bracketed expression giving the relative contributions of the higher order terms is the chief contribution of the present method of attack. AUTHOR.

1468. Wave Functions and Permeabilities for a New Type of Potential Barrier. R. P. Bell. *Phil. Mag.* 25. *pp.* 488–491, *March*, 1938.—In addition to the case of the Eckart barrier [see Abstract 1957 (1933)], an exact solution of the wave equation can be obtained for the continuous curve defined by an alternative expression; moreover, the barrier represented by this expression is considerably flatter at the top than the Eckart barrier and thus resembles more closely the potential energy curve met with in chemical problems. An exact expression for the permeability of this barrier to light particles is deduced, but it involves, however, very laborious calculations if applied to chemical problems. N. M. B.

1469. Comparison of Wave-Functions for HeH^{++} and HeH^{+}. C. A. Coulson and W. E. Duncanson. *Roy. Soc., Proc.* 165*A*. *pp.* 90–115, *March* 18, 1938.—As many different approximations as possible have been used in a comparative study of the wave-functions of HeH^{++} and HeH^{+}. In the latter ion, the molecular-orbital approximation is found to be much better than the electron-pair approximation. Ionic terms and polar terms are included in the final wave-function, and an expansion is given in terms of spheroidal coordinates. The lowest value obtained for the energy of HeH^{+} is − 2·935 a.u., with an internuclear distance of 1·446 a.u. = 0·764 Å. The dissociation energy certainly lies within 0·61 and 2·10 volts, probably about 1·5 volts. The fundamental vibration frequency is 3380 cm^{-1}. AUTHORS.

1470. Electrodynamics of Ponderable Bodies. J. C. Slater. *Frank. Inst., J.* 225. *pp.* 277–287, *March*, 1938.—The present unsatisfactory position of quantum electrodynamics is reviewed. It is suggested that the way to build up an adequate theory is to establish the potential of the radiation field at any point as an average or sum of the potentials due to each individual electron. The general character of such a field would be similar to the self-consistent field of Hartree. G. C. McV.

1471. Use of the "Grand Ensemble" in Statistical Mechanics. H. A. Kramers. *K. Akad. Amsterdam, Proc.* 41. 1. *pp.* 10–24, 1938. *In German.*—Simplified derivation of Gibbs' formulæ for the "grand ensemble" and their equivalent in quantum theory. R. P.

See also Abstracts 1472, 1473, 1477, 1569, 1740.

PHILOSOPHY OF SCIENTIFIC METHOD.

1472. Physical Reality and Dogmatic Atomic Theory. J. Stark. *Phys. Zeits.* 39. *pp.* 189–192, *March* 1, 1938.—The axioms of modern quantum-theory are dismissed as "dogmatic." The axioms of classical theory, *e.g.*, the truth of Maxwell's equations, of which the author approves, are described as "expressing experimental facts in the exact language of mathematics." A physicist must concern himself with experimental discoveries in which no "dogmatic" theories enter. In reply **B. S. M. Rao** [*ibid. pp.* 193-194] points out that Stark's standpoint amounts to saying that complete and logical theories are to be avoided, but that partial and mutually contradictory theories, each one explaining one set of experiments, are permissible. G. C. McV.

1473. Significance of Atomic Entities in Modern Atomic Structure. W. F. G. Swann. *Frank. Inst., J.* 225. *pp.* 289–308, *March*, 1938.—The author develops, in a semi-popular, semi-metaphysical manner, the theme that in present-day developments of physical theory, atomic entities, *e.g.*, electrons, protons, etc., are of little or no significance. Quantum "states" are what are really observed and the interest of physics lies in seeking correlations between these states. The spirit of the quantum theory is that the whole universe is a succession of states. J. S. G. T.

PRESSURE.

***1474. Regulating Device for a Weak Flow of Gas. J. W. Hiby.** *Phys. Zeits.* 39. *p.* 167, *Feb.* 15, 1938.—In the vacuum-sealed leak described, the position of a closely fitting metal cylinder in a glass capillary tube, 10–20 cm. long and 0·3 mm. bore, is controlled by means of a winch operated through a standard ground joint. It it claimed that with a pressure change from 720 mm. Hg to 5×10^{-2} mm. Hg, the gas flow can be accurately controlled within the range 0·5 cc./min. to 50 cc./min. (measured at 720 mm. Hg). A. G. Q.

***1475. Modification of Hickman's Distillation Pump. L. Malter and N. Marcuvitz.** *Rev. Sci. Instruments*, 9. *pp.* 92–95, *March*, 1938.—Hickman has made a contribution to pump development which is outstanding since the original work of Gaede and Langmuir. The authors have checked his conclusions regarding the desirability of incorporating a distillation process in conjunction with the pumping operation. The results are incorporated in a pump design based upon a design of Hickman's. This pump: (1) yields very low ultimate vacua; (2) operates against moderately high backing pressures; and (3) is made entirely of metal. In addition, the authors have made "life tests" on Octoil which indicate its superiority over available petroleum distillates as regards vapour pressure and ability to withstand abuse. AUTHORS.

See also Abstract 1438.

RELATIVITY AND ETHER.

1476. Restrictions of a Theorem of Relativistic Dynamics. H. Hermann. *Zeits. f. Physik*, 108. 3–4. *pp.* 223–224, 1938.—The theorem states that the ratio of the momentum variation in a group of particles to their energy is an invariant under Lorentz transformations. It is shown that this holds only if the Lorentz transformation is taken in the direction of motion. R. P.

1477. Relativity and Quantum Theory. M. Born. *Nature,* 141. *pp.* 327–328, *Feb.* 19, 1938.—The author proposes a "principle of reciprocity" according to which each general law in x-space (space-time dimensions) has an "inverse image" in the p-space (of momenta and energy). He indicates some of the consequences and numerical results: An energetically closed system would correspond to a closed momentum-space, with a radius c representing the maximum possible momentum. A number of quantities which are infinite in accepted theories become finite. Coulomb's law is modified, which implies a change in Rutherford's law of scattering so that for head-on-collisions there is an absolute limit for the distance of closest approach. Planck's and Stefan-Boltzmann's laws and the laws of the kinetic theory of gases are altered. Applied to the theory of nuclear structure, the new principle yields, for the mean kinetic energy per nuclear particle and for the ratio between the nuclear and electronic radii, values in excellent agreement with Bethe's estimates. AUTHOR.

1478. Einstein Spaces in a Space of Constant Curvature. A. Fialkow. *Nat. Acad. Sci., Proc.* 24. *pp.* 30–34, *Jan.,* 1938.—The author gives a summary of his work on Einstein spaces which are defined as n-dimensional Riemannian spaces whose mean curvature is a constant at each point. For the cases $n \geqq 4$ he classifies the various types of Einstein spaces which can be embedded in a real space of $(n + 1)$ dimensions with constant curvature. G. C. McV.

See also Abstract 1537.

SOLUTION.

See Abstract 1691.

SURFACE PROPERTIES.

1479. Adsorption of Gases in Multimolecular Layers. S. Brunauer, P. H. Emmett and E. Teller. *Am. Chem. Soc., J.* 60. *pp.* 309–319, *Feb.,* 1938.—A critical discussion of the polarisation theory of multimolecular adsorption is presented. It is shown that the adsorption energy due to attraction of dipoles induced into a non-polar gas like argon is insufficient to constitute a major portion of the binding energy between adsorbed layers. Derivation of adsorption isotherm equations for multimolecular adsorption are carried out on the assumption that the same forces that produce condensation are also responsible for multimolecular adsorption. Numerous applications of the equations are given to experimental adsorption isotherms obtained by other investigators as well as by the authors. AUTHORS.

1480. Sorption Hysteresis and the Vapour Pressure of Concave Surfaces. L. H. Cohan. *Am. Chem. Soc., J.* 60. *pp.* 433–435, *Feb.,* 1938.—The vapour pressure in equilibrium with the interior of a cylindrical shell of liquid is $P_r = P_0 e^{-\sigma V/rRT}$ where r is the internal radius. The above equation is used to show that in certain sorption systems hysteresis must be expected. In the light of these new considerations an explanation of various experimental results is given. Experiments further to test the views presented are suggested. AUTHOR.

1481. Adsorption of Gases on Plane Surfaces of Mica. M. H. Armbruster and J. B. Austin. *Am. Chem. Soc., J.* 60. *pp.* 467–475, *Feb.,* 1938.—The adsorption of CO and A on mica at −183° has been

determined. For CO the surface is completely covered with a unimolecular layer, but for A only 17% is covered. The adsorption is not instantaneous in either case, showing that the process is not simply physical. CO is adsorbed in two ways. In one it cannot be removed by pumping except at temperatures below −183°, whereas in the other case it can be removed by pumping at −183°. A and the strongly held CO molecules are adsorbed at active centres, these being points on the surface of the mica from which a K atom has been removed by cleavage. The adsorption of both gases follows the Langmuir isotherm, but A is adsorbed at two kinds of elementary spaces. The spreading force of adsorbed CO and A has been calculated. That of A is very small over the entire pressure range investigated.
A. J. M.

1482. Condensation and Adsorption of Mercury Vapour. R. C. Mason. *J. of Applied Physics*, 9. *pp.* 131–134, *Feb.*, 1938.—The critical temperature of glass surface for condensation of Hg vapour as a function of density of atoms striking the surface has been found. The results indicate that a large nucleus composed of many atoms is necessary for condensation to start; the heat of vaporisation of an atom from the nucleus is 13·2 kg.cal./mol. Some qualitative observations are reported, showing both rapid and slow adsorption of Hg atoms on glass and metal, and a considerable adsorption of Hg ions. AUTHOR.

1483. Adsorption of Dimethyl, Diethyl, and Di-*n*-Propyl Ethers by Activated Charcoal. J. N. Pearce and P. E. Peters. *J. Phys. Chem.* 42. *pp.* 229–235, *Feb.*, 1938.—The adsorption of vapours of dimethyl, diethyl, and di-*n*-propyl ethers has been investigated at temperatures between 0° and 183° C. Except for the dimethyl ether isotherms at higher temperatures the Langmuir equation for adsorption on plane surfaces satisfactorily expresses the adsorption magnitudes through the pressure range studied. At low pressures the higher boiling ether is adsorbed more strongly; as the pressure is increased the order of adsorption is reversed. Heats of adsorption of the three ethers have been calculated from the slopes of the isosteres. AUTHORS.

1484. Intermolecular Forces in Two-Dimensional Systems. R. C. L. Bosworth and E. K. Rideal. *Physica*, 5. *p.* 170, *March*, 1938. *In English.*—Corrections to the original [see Abstract 487 (1938)].

1485. Adsorption of Solvent and Solute from a Concentrated Solution. M. Dobine. *Comptes Rendus*, 206. *pp.* 430–432, *Feb.* 7, 1938.—The isotherms obtained by treating aqueous solutions of acetic acid of various concentration (0–100%) with moist and dry carbon are compared and hence the true adsorptions of solvent and solute are deduced. The results are shown by curves. [See also Abstract 991 (1938).] C. A. S.

1486. Simultaneous Adsorption from Dilute Aqueous Solutions. W. J. Jones, R. A. Hudson and J. T. Jones. *Chem. Soc., J. pp.* 269–271, *Feb.*, 1938.—The object of this investigation was to determine, in certain cases, the relative adsorbability of two different solutes from a solution containing both. It has been found that for certain of the investigated systems, the curve relating adsorption to equilibrium concentration is inflected, and this appears to be the first reported instance of such curves with pairs of substances in dilute solution. In all cases investigated, a mutual displacement effect is apparent. At the concentrations employed, it was found that Traube's rule was obeyed in the adsorption of acetone, of methyl ethyl ketone, and of methyl *n*-propyl ketone from aqueous solution. AUTHORS.

V. 19

1487. Surface-Bound Versus Capillary-Condensed Water in Wood. A. J. Stamm and L. A. Hansen. *J. Phys. Chem.* 42. *pp.* 209–214, *Feb.*, 1938.—Adsorption measurements from aqueous solutions of sucrose, glycerol, and NaCl by wood all give selective adsorption of water. In none of these solutions is wood swollen beyond the water-swollen dimensions. Preliminary measurements of adsorption from solutions causing swelling beyond the water-swollen dimensions indicate that positive adsorption of solute is taking place. The selective adsorption of water from aqueous solutions is a function of the activity of the water in the solution. A constant value of 3% is approached in equilibrium with reductions in the relative vapour pressure exceeding 25% which presumably is the adsorption value free from residual capillary condensation and non-equilibrium effects. This value is about half of the predicted surface-bound water. The difference between the values is explained on the basis of the surface-bound water acting as a partial solvent, sharing its bonds between the wood and adjacent solute molecules. AUTHORS.

1488. Surface Tension Constants of the Polyethylene Glycols and Their Derivatives. A. F. Gallaugher and H. Hibbert. *Am. Chem. Soc., J.* 59. *pp.* 2514–2521, *Dec.*, 1937.—Measurements of surface tension and density of polyethylene glycols from monoethylene to heptaethylene glycol and seven of their derivatives over a range of 100° showed (i) a series constant for surface energy of 72 ± 1 erg./cm^2., very close to the value for ethylene oxide, (ii) continuous increase in the Ramsay and Shields constant and in the parachor as the series is ascended, indicating partial orientation of the surface molecules; positive parachor anomalies occurring with the higher homologues (and also with the higher fatty acids) suggest association arising through coordination, (iii) anomalies in molecular volumes, interpreted as indicating a zig-zag structure for the ethylene oxide chain in these compounds. L. V. C.

1489. Oxide Films on Heated Iron. T. Iimori. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 743. *pp.* 60–67, *Dec.*, 1937. *In English.*—The oxide film formed on Fe at various temperatures and pressures of air was studied by means of electron diffraction. A diagram showing the favourable conditions for the formation of the various oxides was obtained. In connection with the stability of superficial lower state oxides, migration of iron atoms into the oxide layer has been suggested. In etched iron, below 340° C, only γ-Fe_2O_3 was formed. In polished iron α-Fe_2O_3 was formed under the same condition. An unknown new primary oxide was found to be formed at lower temperatures. AUTHOR.

1490. Structure and Optics of Evaporated Metal Films. G. Hass. *Ann. d. Physik*, 31. 3. *pp.* 245–263, *Feb.*, 1938.—The structures of thin Sb and Ag films, condensed at low temperatures, were determined by electron diffraction and it was shown that on warming to room temperature and above, extensive recrystallisation occurred which was much more pronounced with Sb than with Ag. In spite of the high-vacuum used, it was found that the cooled metal films became covered with a condensed film of grease which could grow to a thickness of 1000 Å. A protective device is described by means of whch the specimen layer could be kept free from such surface impurities. The optical constants of Sb, Ag and Al mirrors were determined *in vacuo* by a polarisation method and were found to differ considerably from those of the massive metal. Sb showed a strong dependence of the reflecting power, R, upon the structure of the layer; increased grain size and orientation resulting in an increase in R from

46 % to 74 %. From the changes in the values of Δ and 2ψ observed on admission of air, the growth of natural surface layers on the metals was followed, and their thicknesses were measured. A. G. Q.

1491. Structure of Surface Layers of Liquids and Films. S. E. Bresler and P. F. Pochil. *Acta Physicochimica,* 8. 1. *pp.* 129–137, 1938. *In English.*—In an effort to account for the stability of foams and emulsions, molten paraffin $C_{30}H_{62}$ was selected for study because of the orientation of the molecules at its surface. Between 2 and 3° C above the melting point, stable films of thickness 1×10^{-5} mm. (measured electrically) were obtained. Crystals of *p*-azoxy-anisol melt at 118° C. to form an anisotropic phase also having a deep orientation at the surface, and this gives a foam of life up to 9 sec. The isotropic phase formed at 137° C. gives a completely unstable elementary foam. It is shown that viscosity, in the ordinary sense, is not important in the collapse of foams. Dipole liquids, which near the melting point show signs of order in their structure, form stable elementary foams over the narrow range of about 1° C. above the melting point. It was also found that water exhibits a maximum dichroism in thin layers in the immediate neighbourhood of the melting point. P. H. B.

1492. Extension of the Macleod Equation. D. T. Lewis. *Chem. Soc., J. pp.* 261–264, *Feb.,* 1938.—It is suggested that the Macleod constant is a function of the critical temperature of a substance, and it has been established that for similar groups of substances, the critical temperatures, boiling points, and molar heats of vaporisation are connected with the parachor values by simple linear relationships. Divergence from these relationships is taken as evidence of association. By utilising these generalisations, values for the various physical constants of certain elements have been calculated; parachor values so obtained exhibit close agreement with those suggested by Sugden from a study of the periodic variation of the parachor. [See also Abstract 1550 (1937).] AUTHOR.

1493. Mechanical Properties of Adsorption Layers. A. A. Trapeznikov and P. Rehbinder. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 185–189, 1938. *In English.*—The surface viscosity or strength (resistance to shear) was deduced from the logarithmic decrement of an oscillating disc suspended in a unimolecular layer of palmitic, arachidic or cerotic acids, tripalmyin, acetyl stearate, etc., of varying area per molecule (A/M) on an underlying liquid of various pH (3·0 — 6·5) which in some cases contained a trace of some kation ($Al^{\cdots}$, $Ca^{\cdot\cdot}$, etc.). Results are shown by curves and indicate increase in strength with decrease in A/M, and, in a homologous series, with length of the hydrocarbon chain, and also dependence on the nature of the polar group. C. A. S.

See also Abstract 1621.

TIME.

1494. Application of H.F. Modulated Light to the Measurement of Short Intervals. P. Grivet. *Comptes Rendus,* 206. *pp.* 339–342, *Jan.* 31, 1938.—Light from an electrodeless discharge tube excited at high frequencies is received in a photo-cell connected to a circuit in resonance with the tube. If the ray is divided into two beams, one of which passes through a liquid, and which fall on separate cells, the path length of the second ray may be varied so that the light arrives at each cell with the same phase in the presence and absence of the liquid. Hence the velocity of the light in the liquid may be determined. H. G. C.

***1495. Photoelectric Pendulum Control for Recorder Clocks. A. C. Ruge and H. E. McComb.** *Seismological Soc. of America, Bull.* 27. *pp.* 331–335, *Oct.*, 1937.—Describes a photo-cell control mechanism whereby the recording drum of a seismograph is forced to run in synchronism with a master pendulum clock. Details of a suitable photo-cell amplifier circuit are given. J. S. C.

VISCOSITY, FRICTION AND LUBRICATION.

1496. Viscosity of Solutions of Thread Molecules. I. Sakurada. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 407–423, 1938.—The Staudinger empirical viscosity equation is derived from the equation of Einstein and others. The specific viscosity of compounds with high molecular weights increases proportionally to the molecular weight not because the molecules in the solution are fully extended, but because they are crumpled more and more with increasing molecular weight, the effect being proportional to the cube root of the latter. The theory does not assume any particular form for the molecule. The theoretical results are tested by calculating the length of the molecules of long chain compounds of low molecular weight and of natural highly polymerised substances. A. J. M.

1497. Viscosity of Liquid Helium below the λ-Point. P. Kapitza. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 1. *pp.* 21–23, 1938. *In English.*—Anomalies found in the heat conductivity of He below the λ-point, and also in the viscosity determinations, have led to a new determination, by means of a viscometer described. The main result is that the viscosity is so small that even in the slowest flow obtained between plates whose distance apart was estimated at $0 \cdot 5\ \mu$, the Reynolds number was above that for which turbulent flow is to be expected. This fact explains the anomalies mentioned. W. G. B.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1498. Use of Calculating Machines in Astronomy. L. Couffignal.** *Bull. Astronomique*, 10. 3–4. *pp.* 139–202, *and* 5–6. *pp.* 203–270, 1937.—A comprehensive monograph dealing with the solution by mechanical means of problems in celestial mechanics, both from the point of view of the user of actual machines, and with a view to formulating the desiderata of a machine designed exclusively for such work. Following a brief historical note on the development of modern machines, the fundamental attributes of any calculating machine are defined, permitting the comparison of different machines by their fitness for the purpose for which they are constructed. The place of this "descriptive mechanical analysis" in science is discussed, and general laws relating to the mechanical execution of operations are evolved. A chapter is devoted to "preparative mechanical analysis," in which these laws are used to define the mechanical functions necessary for the solution of a given problem. Comparison between the mechanical and manual execution of calculations leads to the conclusion that it is this process which should be the mathematician's prime concern, and not the mere mechanical performance of the isolated arithmetical steps in his work. Machines constructed on these principles should be actually superior to man as much by their accuracy as by their speed, and would bear little resemblance to present-day machines evolved for commercial purposes. Finally, an analogy is drawn between the way in which Napier transformed astronomical formulæ with a view to using logarithms, and the way in which they must again be transformed when these idealised machines are used. Three actual examples of such transformations are given. A. Hu.

***1499. Comparison Image Micrometer. C. R. Davidson and L. S. T. Symms.** *Roy. Astron. Soc., M.N.* 98. *pp.* 176–189, *Jan.*, 1938.—The paper deals with a method of measuring double stars by comparison with an artificial double star. Part I describes the instrument, in which a Wollaston prism is used to produce the double star, the relative brightness of the components being controlled by means of crossed nicols. Part II describes the method of use. Some results of measures of double stars made with the micrometer are given, and compared with filar micrometer results. AUTHOR.

***1500. Pendulum Levelling of Astronomical Instruments. P. Lejay.** *Comptes Rendus*, 206. *pp.* 398–400, *Feb.* 7, 1938.—The use of an elastic pendulum for the measurement of inclinations is discussed. The theory of the instrument indicates that for a realisable form of apparatus a variation of base inclination of 0″·1 causes the pendulum to move through 20″, *i.e.*, 0·01 mm. for a 9 cm. rod. The effects of spontaneous and of thermal alterations in elasticity and of hysteresis are discussed. The pendulum offers advantages over spirit levels in astronomical work: it comes to rest quickly, it has less variance, and it is more sensitive. The performance of the instrument is illustrated by a series of latitude measurements. Time and longitude determinations are to be undertaken shortly with its help. It is claimed that the apparatus is easy to construct and will markedly increase the precision of measurements in all branches of positional astronomy depending on the measurement of inclinations. A. Hu.

COMETS AND METEORS.

1501. Rapid Changes in the Tail of Comet Finsler. J. Ellsworth. *Bull. Astrononomique*, 10. 5–6. *pp.* 271–272, 1937.—Photographs of Comet 1937 *f* obtained at Lyons a few days before perihelion passage are reproduced. On the night of Aug. 3 a secondary tail was visible, and from measurements of two plates taken at an interval of 1¼ hr. it is deduced that this tail must have been moving at 72±7·5 km./sec. away from the nucleus. Plates obtained on the night before and the night after this show no trace of it. A. Hu.

1502. Comet 1936 a (Peltier). G. L. Andrissi. *Accad. Lincei, Atti*, 26. *pp.* 267–271, *Nov.* 7, 1937.—Observations of the R.A. and declination of the comet 1936 a (Peltier) are given for the time May 24 till the end of July, 1937. The observations were made at the observatory of Rome on Monte Mario with a Steinheil equatorial instrument, details of which are given. The R.A. and declination are tabulated. L. K.

COSMOGONY.

1503. Particular Dynamical Solution of the Cosmological Problem. F. F. Campolieti. *Accad. Lincei, Atti*, 26. *pp.* 319–324, *Nov.* 21, *and pp.* 377–382, *Dec.* 5, 1937.—Tolotti has given the general gravitational equations for a universe which possesses spherical symmetry.

V.4
193

The author considers a particular solution of the general equations for the case that the velocity of light varies with the coordinates of space and time and that the geometrical space is Euclidean. The integration of Tolotti's equations under these conditions gives the velocity of light v as function of space and time in the form: $v = c\{1 - h\ (1 - \rho^2/\rho_0^2)\}$, where $c(t)$ and $h(t)$ are arbitrary functions of time and ρ the spatial coordinate, ρ_0 the galactic coordinate. In order to find the relative displacement of spectral lines which come from extragalactic nebulæ, with regard to the frequency of the terrestrial lines, the author derives the expression

$$\frac{\delta\nu}{\nu} = \frac{1}{c}\left\{\left(\gamma + \frac{2a_0}{\rho_0}\right)r + \left(\delta + \frac{2a}{\rho_0} + \frac{a_0}{\rho_0^2}\right)r^2 \times \ldots\right\}$$

The relative displacement of extragalactic lines varies in first approximation linearly with the distance from the galaxy and in second approximation quadratically. As the observed frequency shift is towards the red, $\frac{\delta\nu}{\nu} < 0$, *i.e.*, if $\gamma + \frac{2a_0}{\rho_0} < 0$, then r is positive, and vice versa. It follows furthermore from Tolotti's equations that the energy density ϵ is given by the expression $\epsilon = 4h/\chi\,\{\rho_0^2 - h(\rho_0^2 - \rho^2)\}$ and the pressure of radiation p by $p = (1/\chi)\{\lambda + (4h/\rho_0^2 - h(\rho_0^2 - \rho^2)\}$, where χ is the universal gravitational constant and λ the cosmical constant. By applying the above mentioned relations, it is found that $\chi p - \lambda = \chi\epsilon$. This equation can be interpreted as an analogon to Boyle's law for an ideal gas, if $c^2/\epsilon = v$, where v is the specific volume and the pressure is defined by $\mathrm{P} = \chi p - \lambda$. Consequently, $v\mathrm{P} = \chi c^2$, the volume and the pressure vary from moment to moment and from point to point. In the same way a " temperature " T is defined as $\mathrm{P}v = \mathrm{T}$. The universe behaves like an ideal gas and it follows that for an increasing entropy of the universe, h and c decrease with time, and the velocity of light in the galaxy will decrease in the course of the centuries. This result is not in contradiction with experience, and it is reached without formulating any hypotheses on the position of the galaxy in the universe. L. K.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1504. Restricted Three-Body Problem. N. Rein. *Comptes Rendus*, 206. *pp.* 321–322, *Jan.* 31, 1938.—The form given by Nechvile in 1926 of the differential equations of the restricted elliptical three-body problem is shown to be in error. The relation between certain derived equations and the corresponding ones for the circular problem is accordingly less simple than has been supposed. A. Hu.

See also Abstracts 1512, 1521, 1529, 1530.

LATITUDE AND LONGITUDE.

1505. Determination of Longitude by the Azimuth of the Moon. K. Lous. *Norwegian North Polar Expedition with the " Maud "* 1918–1925, *Sci. Results*, 1. 4. [6 *pp.*], 1928.—[See also Abstract 1530 (1934).]

1506. Change of Plumb Line Referred to the Axis of the Earth from International Latitude Observations (Second Paper). E. Nisimura. *Kyoto Coll. Sci., Mem.* 20. *pp.* 191–195, *Nov.*, 1937. *In English.*—A continuation of previous work [see Abstract 1258 (1913)].

1507. Annual Change in Longitude. F. Schlesinger. *Roy. Astron. Soc., M.N.* 98. *p.* 203, *Jan.*, 1938.—A correction. [See Abstract 5250 (1937).]

1508. Azimuth Variation of the Meridian at Strasburg Observatory. J. Xanthakis. *Comptes Rendus,* 206. *pp.* 171–172, *Jan.* 17, 1938.—An analysis of observations over the period Feb., 1931, to Oct., 1935, has shown seasonal variations of azimuth which can be represented by the equation $dA = 0\cdot71 \cos\delta \sin(\alpha - \odot) + 0\cdot02\,T_m$, where $\odot$ and δ are the right ascension and declination of the sun for the mean dates of observations, α the right ascension of the pole star and T_m the mean monthly air temperature at Strasburg for the period. It is concluded that this is due to refraction which is a maximum when the sun is near the horizon and least when it is near the meridian, while it is also greater in summer than in winter. R. S. R.

NEBULÆ.

1509. Inclinations to the Line of Sight of the Non-Galactic Nebulæ. F. G. Brown. *Roy. Astron. Soc., M.N.* 98. *pp.* 218–222, *Jan.,* 1938.—A discussion of the greatest and least dimensions in 593 non-galactic nebulæ, 2′ or more in dia., north of declination − 20°, reveals an apparent large excess of small inclinations to the line of sight. This is also shown by 109 other nebulæ in the area, down to the same limiting diameter. The evidence suggests that this excess of small inclinations is not the result of observational selection, but is probably a real phenomenon due to a systematic orientation of the planes in space. AUTHOR.

See also Abstracts 1532, 1533.

PLANETS.

1510. Meridian Observations of Jupiter, Saturn, Uranus and the Moon in 1936. L. Gialanella. *Accad. Lincei, Atti,* 26. *pp.* 272–281, *Nov.* 7, 1937.—A continuation of previous work [see Abstract 504 (1936)].

1511. Venus in Maya Astronomy. A. Dittrich. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 326–355, 1937.—The use for calendar purposes in Maya astronomy of the heliacal rising and setting of the brighter fixed stars, and in particular of the planet Venus, is traced from references in the Dresden Codex. A. Hu.

1512. Minor Planet Perturbations. E. Rabe. *Preuss. Akad. Wiss. Berlin, Ber.* 18. *pp.* 209–237, 1937.—Numerical tables are given for the approximate calculation of the perturbations of the minor planets of the Hecuba group by Jupiter. The means used to derive the tables and to check their accuracy are discussed. A. Hu.

See also Abstract 1505.

STARS.

1513. Correlation of Radial Velocities and K-Term with Distances of B-Stars. J. M. Mohr. *Comptes Rendus,* 206. *pp.* 325–326, *Jan.* 31, 1938.—From the well-known formula for the galactic rotation, it follows that the radial velocities of stars in the same galactic positions (after subtracting the sun's motion) are correlated with their distances. Grouping 909 B-stars according to their galactic longitude and also according to distance, comparing the mean observed radial velocities, and calculating the K-term for each group, the surprising result is found that K for B-stars is markedly positive only for those nearest to the sun, being + 3·68 km./sec. for those less than 150 parsecs distant, and only + 1·43 for those between 150 and 300, and $+1\cdot31$ for those over 300 parsecs distant. It appears that the movements of the nearer stars differ from the movements of those more distant, the latter agreeing better with the strict theory of galactic rotation. M. A. E.

1514. Rotation of the Galaxy. E. Esclangon. *Comptes Rendus*, 206. *pp.* 468–471, *Feb.* 14, 1938.—Accurate proper motions, parallaxes, and radial velocities are known only for stars within a few hundreds of parsecs of the sun. It is pointed out that within this small volume E the observations define a continuous field of vector velocities in stellar space. The axes of reference to which these vectors are referred are discussed in view of the fact that no exact astronomy of position exists for the extra-galactic nebulæ. The distortion of E in a few centuries is divided into a translation, a rotation and a pure deformation. The absolute velocity vector at a point in space is calculated on Oort's hypothesis. Mineur's analytic representation of the vector field for B stars [see Abstract 3794 (1935)] is discussed and a cylindrical extension of B stars near the sun is deduced. A much more complex motion than pure rotation is suspected. Little progress can be made until precise measurements of position are available for the spiral nebulæ. A. Hu.

1515. Stark Effect in Stellar Spectra. O. Struve. *Observatory*, 61. *pp.* 53–60, *Feb.*, 1938.—It is pointed out that in B-type dwarfs the members of the diffuse series of He I are more symmetrical than would be expected from Stark-effect patterns obtaining in the laboratory. The $(2p-4d)$ line at λ 4472 should be shifted to the red, and the forbidden line $(2p-4f)$ at λ 4470 to the violet, leaving the space between the two open, on reasonably high dispersion. No such shifts are observed: the broadening is symmetrical and there does exist considerable absorption at λ 4471 which is not due to an instrumental effect. The Lentz-Weisskopf theory of collision damping is applied to the problem, the broadening of the violet wing of λ 4472 in excess of that given by radiation damping being attributed to a damping constant which includes the effect of phase-changing collisions. The observations may be explained by postulating a 20-fold increase in damping constant for the diffuse series as compared with other series in He I. At λ 4471 the symmetrical collisional contour is then superimposed on the unsymmetrical contour produced by the blended Stark patterns. A. Hu.

1516. Ultra-Violet Absorption Spectra of Early-Type Stars. W. S. Adams and T. Dunham, Jr. *Mt. Wilson Observat., Contrib. No.* 583. *Astrophys. J.* 87. *pp.* 102–108, *March*, 1938.—Measures of wave length, estimates of intensity, and identifications are given for absorption lines in the u.v. spectra of two O-type stars and six stars of types B0 to B2. The region investigated is between λ 3050 and λ 3400, results in some cases being added as far as λ 3650. Especially prominent elements are O II, O III, Si III, Si IV, S III, S IV, Ne II, He I, He II, and N II. A list of the interstellar lines observed in the spectrum of 55 Cygni is also given. AUTHORS.

1517. Studies Based on the Intensities and Displacements of Interstellar Lines. P. W. Merrill and R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 585. *Astrophys. J.* 87. *pp.* 118–132, *March*, 1938.—I. Relative intensities of lines of Ca and of Na.—The ratio of intensity D2 : K derived by direct comparison from spectra in which both lines were measured is, in equivalent angstroms, 1·59. A determination based on the distance-intensity curves of the two lines gives 1·65. There is little evidence of a change of ratio with intensity. The value provisionally adopted is 1·6, which probably indicates about three times as many atoms of singly ionised Ca as of neutral Na. II. Absolute magnitudes of early-type stars.—A readjustment of the relative luminosities of the various spectral subdivisions has been obtained from the distance-intensity relationships previously found. The results show (*a*) that differences between stars with diffuse lines and those whose lines are better defined are smaller than the original values; (*b*) that there is a smaller decrease from O9 to B8; (*c*) that *c* stars of classes B3 to B9 are fainter than the assumed mean value, −5·0, while those of classes A0 to A2 are brighter; and (*d*) that the mean magnitude of a few Wolf-Rayet stars is −2·9. III. Galactic rotation.—All available measurements of interstellar lines were utilised to form curves of residual radial velocity against longitude for the four distances, 300, 600, 1200, and 2400 parsecs. These curves approximate fairly closely the double sine curves characteristic of galactic rotation of the "planetary" type, although in longitudes 125°–164° curves for the nearer interstellar material are distorted by a local stream motion which may possibly have some connection with that of the Taurus group. A least-squares solution yields for the constants of galactic rotation $l_0 = 329^\circ$, A = 14·8 km./sec. per 1000 parsecs. The nearer gases give a somewhat larger value of the constant A than those at a greater distance. Obscuration seems inadequate to account for this result, which may possibly be due in part to an average decrease in the density of interstellar gas beyond about 1000 parsecs from the sun. AUTHORS.

1518. Determination of Selective Absorption Based on the Spectrophotometry of Reddened B Stars. J. L. Greenstein. *Astrophys. J.* 87. *pp.* 151–175, *March*, 1938.—An observational programme has been carried out for the determination of the gradients of reddened B stars relative to normal B stars. Short-dispersion spectra, taken in series, were standardised on the tube photometer. The spectra were analysed in the Moll self-recording microphotometer. The magnitude differences between reddened and normal stars along the spectrum were used to determine the gradients and the change of gradient with wave-length. The stars observed were taken from the Stebbins and Huffer catalogue of photoelectric colour indices, which permits a discussion of the relation between the colour indices, the present system of gradients, and the Greenwich system. The relative gradients were found to be substantially linear over a wide range of wave-length. The photoelectric colour index is found to be a representative measure of the reddening of the B stars. The curvature of the gradients is such that the selective absorption in interstellar space must vary nearly as $1/\lambda$. Measures of the total photographic absorption in front of the reddened stars were obtained from star counts, and an independent estimate was made of the ratio of the colour excess to the photographic absorption. The variation of selective absorption with wave-length is again found to be nearly as $1/\lambda$. The total photographic absorption is between four and six times the colour excess of the International Scale. An interpretation on the basis of the author's theoretical discussion of the selective absorption confirms his hypothesis that the interstellar absorption is caused by small dust particles, with a frequency distribution close to that of hyperbolic meteors. AUTHOR.

1519. Distribution of Temperature in Stellar Atmospheres. E. R. Mustel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 147–150, 1938. *In English.*—The author considers a stellar atmosphere in which the radiation consists of two streams parallel to the axis h: an inward stream with the intensity I_ν^1 and an outward stream with the intensity I_ν at a point with the temperature T. The assumption is made that I_ν and I_ν^1 can be represented as Planck's functions with unknown temperatures T_1 and T_2. It is shown that this assumption permits the author to formulate a differential equation which connects the local temperature T with I_ν, I_ν^1 and the absorption coefficient k_ν, if I_ν and I_ν^1 are in equilibrium, and which contains only known functions. The distribution of temperature as a function of the frequency ν of the radiation can be found in this way by an approximative method. L. K.

1520. Origin of Stellar Energy. L. Landau. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 6. *pp.* 305–306, 1937. *In English.*—Despite the strongly endothermic nature of neutron formation from electrons and nuclei a body composed of matter in the neutronic state can become stable when its mass is large enough; this is a consequence of the loss in internal energy in changing from the electronic to the neutronic state being compensated by the gain in gravitational energy. The "critical" mass of a body at which the neutronic state becomes more stable than the electronic state is calculated as of the order of 10^{30} gm. The change of matter from the electronic to the neutronic state is suggested as the probable source of stellar energy. During the sun's probable time of radiation of 2×10^9 years the amount of energy radiated is 3×10^{50} ergs and this quantity could be provided by the transition of only 2% of the solar mass into the neutronic state. In accordance with these conceptions a star is regarded as a body with a neutronic core the steady growth of which liberates the energy necessary to maintain the star at its high temperature. J. E. K.

1521. Impossibility of Stratification of Liquid Rotating Stars. C. Mineo. *Accad. Lincei, Atti,* 26. *pp.* 260–262, *Nov.* 7, 1937.—The author shows that it is possible to prove the impossibility of stratification in liquid rotating stars under the assumption that the density satisfies Poisson's equation, and that it is not necessary to introduce the force lines of the gravitational field or the theorem of Bruns. If the star has spherical symmetry and is in equilibrium, it is found that $2\,w^2 - 4\,a\,f\,g = c_2\,c_3\,a^{\,c_1-1}$, where w is the constant speed of rotation, f the constant of mass attraction, g the density. c_1, c_2, c_3 are constants, and a is a positive parameter which goes from 0 (corresponding to the centre of the star) to A (corresponding to the free surface of the star.) For $c_1 = 1$ the star is homogeneous, for $c_1 > 1$, the density in the centre is smaller than the mean density of the star, and for $c_1 < 1$, the density becomes infinite at the centre. L. K.

1522. Fitting Atmospheres to Stars. H. N. Russell. *Roy. Astron. Soc., M.N.* 98. *pp.* 199–202, *Jan.*, 1938.—Replacement of the outer portions of a model star by material of arbitrarily different composition (so long as the mass involved is a negligibly small fraction of the whole) leads to a new model, likewise in equilibrium, and differing from the original very little in radius and luminosity or in density distribution, except near the surface. Consequences of this proposition are discussed. AUTHOR.

1523. Ionisation in Stellar Atmospheres. M. Krook. *Roy. Astron. Soc., M.N.* 98. *pp.* 204–213, *Jan.,* 1938.—Corrections to the Saha ionisation formula consequent upon the departure from thermodynamic equilibrium in stellar atmospheres are investigated. It is found that if the continuous absorption coefficient is constant throughout the spectrum, corrections can be very considerable, but it is believed that a case of much more physical interest is that in which the coefficient increases strongly with frequency in the remote ultra-violet, and in this case the corrections are negligible. [See also Abstract 2800 (1934).] AUTHOR.

1524. Star Model with Selective Thermo-Nuclear Source. G. Gamow. *Astrophys. J.* 87. *pp.* 206–208, *March,* 1938.—In this note thermo-nuclear reactions as a source of stellar energy are analysed, and it is suggested that the energy-liberating processes are probably of a nature that occurs at some definite temperature ($\sim 10^7$ degrees). It then appears that the shell-source model should provide a satisfactory working basis for the studies in stellar structure. AUTHOR.

1525. Photometry of Stars and Clusters in the Southern Spiral, NGC 7793. H. Shapley and J. Mohr. *Harvard Coll. Obs., Bull. No.* 907. *pp.* 6–12, *Jan.* 1, 1938.—The positions and photographic magnitudes are given of 156 objects in NGC 7793, a large, many-armed, southern spiral. More than half of these objects appear to be supergiant stars, and the remainder are probably close groups or typical galactic-type clusters. From the brightest stars and from the total photographic magnitude, the distance has been estimated as 830 kiloparsecs, the integrated absolute magnitude as $-14{\cdot}9$ (an average luminosity), and the greatest linear diameter, 2500 parsecs. The brightest clusters in the spiral are of absolute magnitude -7. The stellar nucleus is of apparent magnitude 16, but the stellar images along the arms are some three magnitudes fainter, with absolute magnitudes between -5 and -6. AUTHORS.

1526. Stroobant Cluster. A. Festraets. *Comptes Rendus,* 206. *pp.* 235–238, *Jan.* 24, 1938.—Stroobant's original (1910) list of 7 stars whose motion is sensibly parallel and equal to that of the sun, extended in 1923 to include 13, is now considered to comprise 30 stars, whose R.A., dec., parallax, spectral class, and deviation from the apex and space-velocity of the sun are listed. The table has been established with the aid of the Yale parallax catalogue and the radial velocities observed at Lick and at Mt. Wilson. Many of the stars newly recognised as belonging to the cluster fit the conditions better than those already known. It is suggested that we are not dealing here with an ordinary open cluster but with a stream defined by a direction and velocity of motion no doubt slightly different from that of the sun, a non-privileged member of the system. A. Hu.

1527. Observations of Variable Stars by the American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann.* 104. 6. *pp.* 171–201, *and* 7. *pp.* 203–238, 1937. [See also Abstract 5469 (1936).]

1528. Variable Star VV Cephei as an Eclipsing System. S. Gaposchkin. *Harvard Coll. Obs., Circ. No.* 421. [14 *pp.*], 1937.—The well-known irregular variable VV Cephei (spectrum M2ep) has been shown to be an eclipsing system with a period of 20·4 years. In length of period VV Cephei is second only to ϵ Aurigæ. Minimum = J.D. 2421070 + 7430E. The system consists of a supergiant M star and a smaller blue star, probably of Class B. The M star has 2400 times the diameter of the sun, the B star, about 24 times the solar diameter. Thus in disparity of spectrum and actual dimensions, VV Cephei surpasses even ζ Aurigæ. Indeed, the M supergiant is about five times larger than the largest star yet known. The light curve and the velocity curve are given and discussed, and a description of all the Harvard spectrograms by H. A. Cannon is given. A final section contains a general consideration of the seven most massive known eclipsing stars, from the standpoint of the mass-luminosity relation, the central condensation, and the H content. AUTHOR.

1529. Differential Correction of the Orbit of a Visual Binary. W. H. van den Bos. *Union Obs., S. Africa, Circ. No.* 98. *pp.* 337–341, *Aug.* 27, 1937.—The differential improvement of the first orbit of a visual binary is generally obtained by treating the observed angles, or normal places, according to the method of least squares. There are, however, two serious objections to this procedure. The first is a purely practical one: in the majority of cases the result obtained is hardly commensurate with the labour of deriving and solving normal equations for 6 or 7 unknowns. The second is that the character of the errors inherent in micrometric observations of double stars is not such that the most satisfactory orbit necessarily leaves a minimum for the sum of the squares of the residuals. The least-squares solution may even be at times unacceptable to the computer. A method which enables the required corrections to be obtained with less trouble than by least squares and at the same time gives full scope to the computer's judgment of a satisfactory fit is outlined. It has been tested on a number of orbits and has given satisfaction. A. Hu.

1530. Orbital Elements of Visual Double Stars. A. Danjon. *Comptes Rendus*, 206. *pp.* 322–324, *Jan.* 31, 1938.—The usual method of determining the orbital elements of visual binaries is by graphically representing as functions of the time t the separation ρ and position angle θ, thence obtaining a preliminary apparent orbit which can be corrected to an ellipse satisfying the law of areas. The author points out that in practice, since the measurement of ρ is so subject to error, most of the corrections are applied to this quantity, and the orbit is practically determined by the curve $\theta(t)$. No procedure exists, however, for assigning relative weights to the quantities, and the method involves the calculation of $d\theta/dt$, a derivative less well determined than the original function. A method is outlined by which for binaries well enough observed, all the elements except the semi-axis major of the true orbit can be obtained from the curve $\theta(t)$ alone, without recourse either to its derivative or to the apparent orbit. A. Hu.

1531. Photographic Magnitudes of Super-Nova 145·1937 Persei in N.G.C. 1003. A. Beer and C. C. L. Gregory. *Roy. Astron. Soc., M.N.* 98. *pp.* 216–217, *Jan.*, 1938.

1532. Bright Nova of 1860 in Globular Cluster Messier 80, and its Relation to Supernovæ. H. B. Sawyer. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 69–90, *Feb.*, 1938.—This is the only nebula yet found in a globular cluster. The author gives an account of the 1860 Nova first seen on 21st May, 1860, in Scorpion by Auwers, and its observation later by Luther, Pogson and others, together with its light curve from May 21 to June 16; she concludes from various evidence that the Nova was actually a cluster member; its absolute maximum magnitude was −9·2, or 3 magnitudes brighter than the average galactic Nova, but much less than the average Supernova, of which a list of 20 is given {from S And. (1885) to I 4719 (1937)}; to these should be added Tycho's Nova in

Cassiopeiæ (1572). She decides that the Messier 80 Nova is either the brightest ordinary Nova known, or else the faintest Supernova. A Bibliography is given: (1) of the Messier 80 Nova; (2) of Supernovæ; and (3) of general references on Supernovæ. A. S. D. M.

1533. Features of a Planetary Nebula and a Nova. Y. Hagihara. *Observatory*, 61. *pp.* 45–52, *Feb.*, 1938.—(1) A Nova is considered as a central star radiating Lyman Continuum only, with a spherical detached hydrogen shell; diagrams indicate that the momentum increases rapidly with the shell's increasing optical thickness; it is unstable and will be destroyed by a small disturbance at any instant. If formed the shell must expand until its thickness is small enough; else it must fall back on the star. This diminution of optical thickness is important in retarding the expansion of the Nova's shell when fairly detached from the star. (2) A spherical hydrogen shell when detached from the central star of high temperature, and rotating about its axis fixed to the nebula, will have its inner and outer boundaries prolate spheroids, the inner having less eccentricity; if the nebula is too thin for much L_α radiation to form inside it, the outer boundary will be oblate. (3) The effective temperature of the central star must exceed 1500° C. to have a ring-type nebula, and it may be a white dwarf. But the sun, for example, cannot retain a planetary nebula in statical equilibrium. A. S. D. M.

See also Abstract 1548.

SUN.

1534. Spectrum of Solar Corona at Total Eclipse in 1936. Part II. Continuous Spectrum. T. Tanaka, Z. Koana and M. Kondô. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 52–81, *Jan.*, 1938. *In English.*—The continuous spectrum of the solar corona at the total eclipse in 1936 was investigated in the equatorial region, by photographic photometry. The range of wave-length studied was from 4100 to 6500 Å, and that of the distance from the sun's limb is from 0·07 to 1·10 times as much as the radius of the sun. The relative magnitude of the brightness of the corona changes by the same law for all wave-lengths, which is shown in a table. The law is approximately represented by $B = c/(h+0{\cdot}140)^3$, and the mean slope of the curve representing $\log B = f(\log h)$ by $B = c'/h^{2.07}$. All reliable results published hitherto do not deviate much from each other for the same range of h, whether the type of the corona is maximum or minimum. The continuous spectrum of the corona is identical with that of the photosphere for the wave-lengths shorter than 6200 Å. For the wave-lengths longer than 6200 Å, the absorption band of O_2 in the earth's atmosphere seems to cause a remarkable modification. [For Part I see Abstract 3958 (1937).] AUTHORS.

1535. Equivalent Widths and the Temperature of the Solar Reversing Layer. D. H. Menzel, J. G. Baker and L. Goldberg. *Astrophys. J.* 87. *pp.* 81–101, *March*, 1938.—Allen's extensive determinations of equivalent widths of Fraunhofer lines provide important observational material for an analysis of the physical state of the solar atmosphere. A comparison of the observed intensities of absorption lines, as read from an empirical curve of growth, with the theoretical strengths of lines in a transition array makes it possible to calculate the effective excitation temperature of the reversing layer. Temperatures of 4350° ± 200° and 4150° ± 50° are computed from the lines of Ti I and Fe I, respectively. A qualitative discussion of the errors inherent in the theoretical calculation of multiplet strengths is given, and a method for calculating the reversing-layer temperature by means of the J-file sum rule is described. The application of this method to the lines of Ti I yields a temperature of 4400° ± 100°. Since the sum rule is independent of the coupling in an atom, and is therefore free of the assumptions involved in the calculation of multiplet strengths, the value 4400° is adopted, for purposes of discussion, as the mean excitation temperature of the solar reversing layer. If the opacity of the solar atmosphere varies with wave-length, we should expect to find the numbers of atoms, as derived from equivalent widths, depending upon wave-length as well as upon the temperature and excitation potential. The data for Fe indicate an opacity law almost independent of wave-length. These results, however, are not definite. Since the mean lower excitation potentials increase systematically with wave-length, opacity and temperature effects are correlated. The data for Ti, where no systematic correlation exists, are not inconsistent with an opacity varying as λ^3, whereas theory predicts a law varying approximately as $\lambda^3 e^{-hc/\lambda kT}$. An attempt is made to reconcile the observations and the theoretical values. AUTHORS.

1536. Stellar Groups Moving with the Sun. L. Gialanella. *Accad. Lincei, Atti*, 26. *pp.* 446–452, *Dec.* 19, 1937.—It is found that 122 stars form the stellar aggregate moving noticeably together with the sun. They are divided into two groups, a first group of 36 stars of a relative spatial velocity smaller than 4 km./sec., and a second group of 86 stars of a velocity between 4 and 7 km./sec. A catalogue is given of these stars together with their coordinates, magnitudes, spectral type, radial velocity, parallaxes, their proper motion and calculated spatial velocity. L. K.

1537. Red Shift of the D Lines of Sodium in the Sun. J. Evershed. *Roy. Astron. Soc., M.N.* 98. *pp.* 195–198, *Jan.*, 1938.—By means of multiple transmission through a liquid prism containing methyl naphthalene, measures have been made of the shift of the line D I in high-dispersion spectra of the sun compared with similar spectra of a low-pressure Na lamp. A table is given showing the shifts, corrected for the motion of the earth, at the centre of the sun, at the equatorial and polar limbs and in spot latitudes. Unlike the lines of Fe or Ca, the Na line is found to give the same shift towards red at the centre of the disc as at the various points on the limb, and this shift agrees very closely with the Einstein relativity effect. The constancy of the shift of the solar lines was tested by photographing the Fe lines in the H and K region, and these spectra were found to yield the same values for the shifts as had been observed in former years, namely, nearly twice the relativity effect, at the sun's limb. AUTHOR.

1538. Spark Spectrum of Iron, λλ 5016–7712 with Identifications of Fe II Lines in the Solar Spectrum. A. S. King. *Mt. Wilson Observat., Contrib. No.* 584. *Astrophys. J.* 87. *pp.* 109–117, *March*, 1938.—The spectrum of Fe from a strong spark discharge was examined in the region of wave-length above λ 5000. Wave-lengths of 127 lines due to ionised iron were obtained, in the main belonging to Fe II, although the structure of a few lines suggests Fe III as a possible origin. A comparison with the solar spectrum resulted in the identification of 78 lines in this region as due at least in part to Fe II. Of these, 37 were identified as Fe II in the *Revised Rowland*. Other solar lines were found to agree with Fe II lines previously predicted from term values and now measured in the spark spectrum. In addition to the solar lines clearly identified, 13 Fe II lines are masked by foreign lines, and their identifications are uncertain. Since a large proportion (31) of the lines identified as Fe II have the faintest solar intensities (−2 and −3), the identification of solar Fe II lines in this region is probably essentially complete. The lines measured in the spark spectrum include lines, some of them predicted, which are prominent in the spectra of Novæ. AUTHOR.

See also Abstract 1456.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

See Abstracts 1423, 1536.

HYDROSPHERE, PHYSICS OF THE.

1539. Tidal Observations. J. E. Fjeldstad. *Norwegian North Polar Expedition with the "Maud"* 1918–1925, *Sci. Results*, 4. 4. [88 *pp.*], 1936.—[See also Abstract 1530 (1934).]

1540. Spectrographic Research on Elements Existing as Traces in Sea Water. J. Bardet, A. Tchakirian and R. Lagrange. *Comptes Rendus*, 206. *pp.* 450–452, *Feb.* 7, 1938.—Tests for the presence of various elements (1) by spectrographic examination of sea water and then concentration to 1/60th of its volume by evaporation, and (2) by concentration through crystallisation and analytical examination, are described. In this way all elements previously found were confirmed except Ni and W, while Au was found only in tests near Senegal. Quantitative results results are given for Mo and Cu. R. S. R.

1541. Surface Motion of Water Induced by Wind. I. Langmuir. *Science*, 87. *pp.* 119–123, *Feb.* 11, 1938.—To account for " streaks " parallel to the wind direction, which develop in open water surfaces, the author assumed the presence in the water of a series of right and left handed helical vortices, having horizontal axes parallel to the wind. Their presence was proved by extended observations involving measurements of water currents and of temperature. The vortices are believed to extend to the depth of the isothermal layer at the surface (epilimnion), without penetrating below into the thermocline, and to constitute the essential mechanism whereby the epilimnion is produced. P. H. B.

See also Abstract 1566.

LAND, PHYSICS OF THE.

1542. Formation of Periodic Ice Streaks during Soil Freezing. F. M. Šemiakin and P. F. Mikhalev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 8. *pp.* 405–407, 1937. *In English.*—By using an analogy between the differential equations of diffusion and heat conduction a law has been obtained giving the spacings between ice-streaks in frost-heaving. The law is in accordance with the observations of S. Taber. W. A. R.

1543. Seepage of Water from an Open Channel into Deep Soil. G. Hamel. *Zeits. f. angew. Math. u. Mechanik*, 18. *pp.* 39–43, *Feb.*, 1938.—A general solution is given of the problem of the seepage of water

V. 19

out of a channel down through sandy ground for which Darcy's Law holds. The flow is steady and two-dimensional, and at a great depth the velocity is constant in direction and magnitude, the pressure being constant and equal to the atmospheric pressure. The section of the channel, assumed to have a plane of symmetry $y = 0$, has a boundary which is assumed to be a kind of generalised cycloid, expressible by the equations

$$x = \sum_{n=0}^{\infty} a_n \cos (2n+1)\omega, \; y = b\omega + \sum_{n=0}^{\infty} a_n \sin (2n+1)\omega \left(-\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \right),$$

where x is measured vertically downwards from the free water surface. If k is the velocity at infinity, $2q$ the seepage flux, then $-\frac{1}{2}\pi b = q/k$. The maximum depth of the channel is Σa_n, and its semi-breadth is $q/k - \Sigma (-1)^n a_n$. The problem is solved by complex-variable theory. The seepage flow is limited by the curves

$$\pm y = q/k - \Sigma (-1)^n a_n \exp\{(-\pi/2q)(2n+1) kx\},$$

and at the boundary of the channel the velocity is given by

$$\frac{1}{u-iv} = \frac{1}{k} - \frac{\pi}{2q} \Sigma (2n+1) a_n e^{(2n+1)\omega i}.$$

S. G.

1544. Tectonic Problems in the Light of Modern Knowledge. I. Ruud. *Gerlands Beitr. z. Geophys.* 52. 1–2. *pp.* 123–169, 1938.—Investigations of the ways in which rocks crystallise and differentiate are now more fully known. The bearing of these processes on the production of the major features of the earth and the moon is discussed in this paper. W. A. R.

METEOROLOGY.

1545. Observations in Highest Stratosphere Flight. *Nature,* 141. *pp.* 270–274, *Feb.* 12, 1938.—The observations were made near Dakota on the Explorer II [see Abstract 2503 (1937)]. They included observations on cosmic rays, ozone, electrical conductivity, air composition and micro-organisms. A series of ionisation depth curves gives the number of counts for cosmic rays for both shielded and unshielded counters at angles ranging from 0° to 90° with the vertical. The curve found showing the distribution of ozone does not agree well with those found by other methods. The electrical conductivity was found to be enormously greater at high altitudes than near the ground. The results are represented graphically. An analysis of the air from the stratosphere gives the oxygen and CO_2 content almost the same as at ground level, while as regards micro-organisms, five types of bacteria and five moulds were found. A description of the apparatus used in the investigation of each phenomenon is given. A. E. M. G.

1546. Variations in Temperature of the Free Atmosphere. H. Garrigue. *Comptes Rendus,* 206. *pp.* 267–269, *Jan.* 24, 1938.—This investigation deals with very minute temperature differences. The observations, carried out on board an aeroplane, were made with the help of thermocouples. A description of the apparatus used is given, and the method of its calibration in the laboratory indicated. A table shows the order of temperature differences observed. Observations near Pau show that there exists in the free atmosphere volumes of air perfectly stable: also that in successive lengths of about 12 m. the variations may not be more than a few thousandths of a degree. A. E. M. G.

1547. Theory of Monsoons. W. W. Shoulejkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 7. *pp.* 351–357, 1937. *In English.*—Continuing his work on the theory of monsoons [see Abstract 3973 (1937)] the author endeavours (1) to find quantitative connection between the dimensions of the sea (or continent) and such elements as the maximum velocity of the wind or the characteristic differences of temperature between the warmest part of the sea and the coldest portion of the continent; and (2) to investigate the monsoon field when the shape of the coast differs from the circular. Expressions are found giving the relations referred to in (1). To solve the problem in (2) the relation grad $p = -\pi$ grad τ, discussed in the first paper of the series is used. There is found everywhere in agreement with this relation a striking likeness between climatological isobars and those of temperature isonomalies. Several special cases are investigated. At points where the gradients of temperature anomaly and so also those of pressure are high, monsoons get their birth. The strong winds and storms at the Cape of Good Hope arise in this way. Diagrams and charts illustrate the paper.
A. E. M. G.

1548. General Circulations and their Perturbations. A. Giào. *Gerlands Beitr. z. Geophys.* 52. 1–2. *pp.* 20–67, 1938. *In French.*—The problem of gyratory motion around the poles of fluid stars with or without a solid nucleus is treated and equations are sought which satisfy the variables (angular rotation, density, pressure, temperature) characteristic of the circulation. Two methods are used to obtain the differential equations of angular rotation, one involving the Navier-Stokes expression and the other the theory of fields given earlier by the author. The equations of density are found for the density field with permanent gyratory movement. The general circulation being the direct effect of external action, this leads to a solution of the differential equations and the integration is simplified since all external effects are independent. Integration is then carried out for no nucleus and for a solid spherical nucleus. This leads to a general solution for the atmosphere at rest on a non-spherical nucleus. Finally modifications of revolutions of gyratory circulation are studied.
R. S. R.

***1549. Photoelectric Anemometer for Studying Atmospheric Turbulence. R. Faillettaz.** *Comptes Rendus,* 206. *pp.* 358–360, *Jan.* 31, 1938.—A photo-cell is used in one pair of plates of a kathode-ray oscillograph and is sheltered from direct daylight or from an artificial source of light by a small leaf of paper or similar material, coated to make it insensible to heat or humidity. The leaf is deformed by wind so that the light reaching the cell varies and the deflection of the kathode beam is a measure of the deviation of the wind velocity. Two exactly similar cells shaded by equal leaves perpendicular to the wind and parallel to it are respectively joined to each pair of oscillograph plates and give a statistical image of the deviation of the mean velocity of the components of the wind velocity. A photograph of the result shows usually as an ellipse and the degree of blackness from centre to edge gives an indication of the frequency of the deviation of the mean velocity. Using only one cell and putting a p.d. of known frequency on the other pair of plates, greater details of the wind gusts can be obtained by a kinematograph.
H. M. B.

1550. Air Cells in Snowflakes and in other Forms of Ice. C. M. Heck. *Monthly Weather Rev.* 65. *p.* 364, *Oct.,* 1937.—An examination of air cells in snowflakes shows that when the cell is punctured, the melted water runs up to about 40% of its length. When air cells in ice formed at the earth's surface are examined no such contraction is found, but the shapes of the cells are seen to be very characteristic. The cells in columns of ice forced up from the ground on cold nights appear to contain air at a pressure above the external pressure. Cooperation with the author in this investigation is invited. A. E. M. G.

1551. Variation of Frost Frequency in Air and Ground. E. Heyer. *Gerlands Beitr. z. Geophys.* 52. 1–2. *pp.* 68–122, 1938.—General relations are established between frost frequency and the depth in the ground, the height above the surface, and the effect of snow or vegetative covering together with their monthly and annual variations. In the ground the frequency is inversely proportional to depth, but in air, above the surface layers, the frequency is almost constant for 30 m. The yearly variations in the ground and air are different. These differences depend upon temperature, temperature amplitude, cloudiness and relative humidity differences. A relation, approximately true in Germany, is given for frost frequency in relation to snow covering but this depends upon relief of the ground and the kind and density of woods. R. S. R.

1552. New Fluorescence Phenomenon in the Upper Atmosphere. R. Bernard. *Comptes Rendus*, 206. *pp.* 448–450, *Feb.* 7, 1938.—Observations at Tromsö and Aubin (Basses Alpes) confirmed the existence of a band at 5893 Å which shows more and more clearly in the sky at twilight as the sun sinks and then in 1 to 2 min. fades to 1/100th of its intensity. It seems to originate in a layer at a height of 60–80 km. Photoluminescence due to solar u.v. radiation and absorption by O_3 is ruled out since this requires a height for the layer of 110 km., but optical resonance due to rays traversing the atmosphere near the horizon and the action produced by Na atoms at a height of 60 km. and a temperature of 150° C. is considered to be the cause. R. S. R.

1553. Atmospheric Absorption and Molecular Diffusion. Tien Kiu. *Comptes Rendus*, 206. *pp.* 452–455, *Feb.* 7, 1938.—Using the Rayleigh-Cabannes theory an equation is established for the optical density of the atmosphere at the zenith in terms of pressure, number of molecules per cm^3. (n_0), refractive index and wave-length. The height of the ozone layer, $D_\lambda = A + Bf(\lambda)$. Results for 462 days over the period 1920–30 at Montezuma were used. Values of A and B were found to depend on the amount of precipitable water vapour and values are quoted. For n_0 the value is between $2 \cdot 8$ and $2 \cdot 9 \times 10^{19}$ which agrees well with Millikan's theoretical value $2 \cdot 70 \times 10^{19}$. A seasonal variation of A is also found. R. S. R.

1554. New Band in the Absorption Spectrum of the Earth's Atmosphere. A. Adel and C. O. Lampland. *Astrophys. J.* 87. *pp.* 198–203, *March*, 1938.—A new band at $7 \cdot 6\,\mu$ in the absorption spectrum of the earth's atmosphere has been correlated with the probable presence of minute quantities of N_2O_5 in the ozonosphere. AUTHORS.

1555. Aurora of Jan. 25, 1938. H. Garrigue and H. Camichel. *Comptes Rendus*, 206. *pp.* 527–529, *Feb.* 14, 1938.—Photographic observations of the phenomenon were made at Pic du Midi, lat. 43° N., with two special spectrographs used for studying the night sky. A complete set of eye observations was also made. The latter are given in detail while the results of the former are summarised and discussed, some numerical values being given. All go to show that this particular aurora stands in a class by itself. It is the first which has been observed at Pic du Midi. A. E. M. G.

***1556. New Psychrometer with Resistance Thermometers and Differential Crossed-Coil Measuring Apparatus. J. Möller.** *Zeits. f. techn. Physik*, 19. 2. *pp*. 30–34, 1938.—Reference is made first to the procedure adopted by Lieneweg using two Wheatstone bridges to obtain the relative humidity from the dry bulb temperature and its difference from the wet bulb. A new improved procedure is then described by means of which from the same principles the relative humidity can be found to ± 3% over a wide range of temperature from variations of tension in the crossed coils. With similar rules the absolute humidity or temperature difference can be measured independent of the observed temperature. R. S. R.

See also Abstracts 1564, 1565.

SEISMOLOGY.

1557. Unsolved and Partially Solved Seismological Problems. N. H. Heck. *Seismological Soc. of America, Bull.* 28. *pp*. 33–38, *Jan.*, 1938.—The difficulties of earthquake prediction are first discussed. In the determination of crustal stress the errors due to methods of triangulation, levelling, and tilt are examined. An acoustical method to determine crustal stress by using microphone stations is considered. Causes of earthquakes and changes produced in earth movement are treated. For building construction an exact knowledge of the position of faults is required, and the problems of structural design and insurance in relation to earthquakes are discussed. R. S. R.

1558. Travel Times for Shear Waves in a Granitic Layer. F. Birch. *Seismological Soc. of America, Bull.* 28. *pp*. 49–56, *Jan.*, 1938.—Travel times for shear waves in a layer of granite have been computed on the basis of recent laboratory work which permits an approximate evaluation of the variation of velocity with depth. The results are found to agree very closely with those of Leet (*ibid. pp*. 45–48), found by the method of timed blasts, for New England. The mean surface velocity of shear waves in granite having their focus at the surface is computed to be 3·52 km./sec. at 568 km., decreasing to 3·26 at 25 km. ; the curvature is shown to be too small to be easily recognised from records of near earthquakes. A depth of 15 km. for the granitic layer is shown to be consistent with Leet's observations of pulses through a second layer. AUTHOR.

1559. Vibrations of Bridges. D. S. Carder. *Seismological Soc. of America, Bull.* 27. *pp*. 267–303, *Oct.*, 1937.—The records of observations of the vibrations of a number of large American bridges, including Golden Gate and the Oakland Bay Bridge when in course of construction, are given. W. A. R.

***1560. Earthquake Accelorometers on Shaking Table. H. E. McComb and A. C. Ruge.** *Seismological Soc. of America, Bull.* 27. *pp*. 325–329, *Oct.*, 1937.—A preliminary account (illustrated) of the method of working of the accelerograph in connection with the machine for reproducing earthquake motion from a shadowgraph [see Abstract 5492 (1936)] and a microtilt apparatus to simulate motion of large amplitude and long period, with some indication of the results it is hoped to obtain. C. A. S.

***1561. Elementary Theory of the Spring Suspension of the Vertical Seismograph. G. L. Schnirman.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 6. *pp*. 311–314, 1937. *In*

English.—The case is taken of a vertical seismograph consisting of a mass suspended on a cylindrical spiral spring and having a horizontal axis of rotation. The assumptions made in the theory are given. For simplicity a special case with the length of the non-deformed spring taken as zero is first treated. Next the general case is taken and this leads to an expression holding in all cases. R. S. R.

*1562. **Theory of Vibrograph. F. Gassmann.** *Gerlands Beitr. z. Geophys.* 52. 1–2. *pp.* 1–19, 1938.—The equation of the indicator of a vibrograph possessing one degree of freedom is obtained when translation or rotation of the ground occurs even if these movements cannot be regarded as small vibrations about a fixed point. Allowance has been made in the equation for the influence of the inclination of the apparatus on the frequency of its own vibrations. This equation is applied (1) to derive the constants of the apparatus, (2) to deal with small vibrations of the ground, translatory or vibratory, and thus with a vibrograph to determine completely these vibrations, and (3) to obtain a generalised equation to measure small vibrations in relation to a system of coordinates, not fixed, but moving in any translatory or vibratory way. The last applies to vibrations of a vehicle on land, in water or the air, as well as to vibration measurement with a torsiograph. The results are applied to vibrations of a railway carriage moving on a curve. R. S. R.

See also Abstract 1495.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1563. Photographic Study of Lightning. R. E. Holzer, E. J. Workman and L. B. Snoddy. *J. of Applied Physics*, 9. *pp.* 134–138, *Feb.*, 1938.—A simple method of analysing lightning photographs taken with moving film cameras is described. The results of analysis of two air discharges with some interesting features and one very unusual type of discharge are presented. Certain discharges at the close of storms and the correlation of electrical and photographic measurements are discussed. AUTHORS.

1564. Photoelectric Ionisation in the Ionosphere. E. O. Hulburt. *Phys. Rev.* 53. *pp.* 344–351, *March* 1, 1938.—The ionisation equilibrium in the various atmospheric gases is calculated from the Saha theory on the assumption that the spectral energy curve of sunlight for u.v. frequencies above the limits of the principal series is that of a black body at 6000° K. A calculated region of ionisation due mainly to O_2 and partly to N_2 is found at about 200 km. with maximum electron density $1 \cdot 6 \times 10^6$, in agreement with F_2 observation in winter temperate latitudes. The assumption of an expansion of the high atmosphere under the sun, with resulting winds and diffusion, leads to a partly quantitative explanation of the observed seasonal changes in F_2, and to a qualitative explanation of F_1. In the case of E-region the equations do not indicate what radiation causes the ionisation nor what gases are ionised. This may be due to the omission in the theory of the possibility of ionisation by frequencies below the series limits. Calculation suggests that E ionisation is mainly ionic resulting from two processes, the first being the formation by the ionising radiation of positive ions and free electrons, and the second being the formation of negative ions by the attachment of the electrons to O_2 molecules. AUTHOR.

1565. Ionisation Balance and Amount of Radium Emanation in the Atmosphere. J. Clay and L. J. L. Dey. *Physica*, 5. *pp.* 125–128, *March*, 1938. *In English.*—The ionisation of the atmosphere depends upon three factors: the γ-radiation of the soil, the cosmic radiation and the radiation of the emanation and its decay products in the atmosphere. In Amsterdam the γ-radiation gives 1·6 I, the cosmic radiation 1·66 J. These two factors are subject to only small variations. The amount of emanation was recorded directly by two instruments every 10 min. Immediately at the bottom the amount of emanation is on the average 230×10^{-18} Curie/cm^3. and the ionisation when in equilibrium with the decay products is 4·5 J with a daily variation of about 2·25 J. AUTHORS.

1566. Magnetic Survey of the Oceans. J. A. Fleming. *International Aspects of Oceanography, pp.* 50–56, 1937.—The history of magnetic surveys at sea is shortly recounted from Halley's expedition, 1696–1700, to the loss of the "Carnegie" in 1929. More information is required on secular variation changes, in the interests of navigation, but future magnetic and electric data are far more necessary to advance theoretical studies. The variation in the crustal thickness indicates that further data bearing on the surface distribution of the secular change activity promise conclusions concerning the secular variation processes which are localised in the crustal area. The need of continued work at sea is emphasised, and reference is made to the British non-magnetic vessel, "Research." It is hoped that the hydrographic services of maritime nations will be stimulated to take a share in the work. The paper contains maps of the tracks of the chief survey vessels over the oceans, and graphs of the annual change $\Delta H/H$ as it varies with latitude and longitude. G. E. A.

***1567. Impedance Magnetometer. E. P. Harrison and H. Rowe.** *Phys. Soc., Proc.* 50. *pp.* 176–184, *March* 1, 1938.—A magnetometer for measuring local variations of magnetic field uses the fact that the impedance of a nickel-iron wire of high permeability varies with the axial component of the magnetic field in which the wire is placed. AUTHORS.

See also Abstract 1545.

RADIOACTIVITY.

1568. Angular Distribution in Nuclear Transitions. C. Reinsberg. *Zeits. f. Physik*, 108. 3–4. *pp.* 189–194, 1938.—In an inelastic impact between two nuclei, an intermediate nucleus is frequently formed which again disintegrates into two further nuclei. By a consideration of the law of the conservation of angular momentum, and of the selection rules as applied to the parties to the collision, it can be shown that the resulting nuclei should exhibit a distribution in angle. On these assumptions the theoretical angular distributions are obtained for transitions involving H^2, Li^6, Li^7, B^{11}, protons, etc. Comparison with the experimental results is satisfactory. G. O. B.

1569. Approximately Relativistic Equations. G. Breit. *Phys. Rev.* 53. *pp.* 153–173, *Jan.* 15, 1938.—The wave-equations suitable for discussing nuclear interactions are considered. Approximate relativistic invariance down to the order $(v/c)^2$ is postulated, where v is the velocity of the particle concerned. Various types of interaction forces are dealt with, the wave-functions of the particles having two components. Further investigation leads to the conclusion that, even in approximate treatments, the equations should be regarded as approximations to equations with four components per particle. It is pointed out that many existing estimates of the magnetic interaction-energy of the deuteron are not sound.

G. C. McV.

1570. Long Period Activity of Indium Produced by Slow Neutrons. A. C. G. Mitchell. *Phys. Rev.* 53. *pp.* 269–272, *Feb.* 15, 1938.—In was irradiated with slow neutrons from a Ra-Be source for a period of several months. A period of 45 ± 3 days was produced quite strongly. It is shown that this period is produced when In^{113} captures a neutron to form In^{114}. The ratio of the activity of the long period to that of 54 min. due to In^{116}, is approximately the same as the isotope ratio In^{113}/In^{115}. The capture cross-sections for the two processes are given by the relation $\sigma_{113} = 0{\cdot}56\sigma_{115}$. AUTHOR.

1571. K-Electron Capture and Isomerism in Radiosilver. M. L. Pool and E. C. Campbell. *Phys. Rev.* 53. *pp.* 272–274, *Feb.* 15, 1938.—From radioactivity data a tentative energy-level diagram is constructed for the isomeric nucleus Ag^{106}. These data indicate that, for the 8·2-day period, the relative probabilities of K electron capture : negative β-emission : positive β-emission = 640 : 40 : 1. The 24·5-min. Ag^{106} level is metastable and 0·3 eMV above the 8·2 day Ag^{106} ground state. Theory requires that the difference in angular momentum associated with these two levels be at least 5 nuclear units. AUTHORS.

1572. Emission of Neutrons from A, Cl, Al and Heavier Elements Under α-Particle Bombardment. E. Pollard, H. L. Schultz and G. Brubaker. *Phys. Rev.* 53. *pp.* 351–356, *March* 1, 1938.—The emission of neutrons from Cl, A, Sc, Ti, Mn and Fe under β-particle bombardment was established. The yield from A is considerable and enabled a measurement of the energy of the neutrons to be made : the majority are associated with a group of energy change −5·6 ± 1·0 eMV, but two groups must be present. The excitation curve for these neutrons was plotted for α-particle energies between 3·5 and 9·0 eMV and varies smoothly in agreement with penetration through a barrier of radius $7{\cdot}6 \times 10^{-13}$ cm. This smooth variation means that the total neutron yield does not change rapidly as a new group is excited, from which it is deduced that observations on single groups would show apparent resonance effects. The excitation curve for Cl fits a theoretically derived function for a nuclear radius of $6{\cdot}0 \times 10^{-13}$ cm. and a similarly plotted curve for Al agrees with a radius of $5{\cdot}8 \times 10^{-13}$ cm. These last elements have radii approximately fitting the formula $R = R_0A^{\frac{1}{3}}$ with $R_0 = 1{\cdot}94 \times 10^{-13}$, while A has a radius which is definitely too large to fit the above relation. This abnormally large radius is linked with the large neutron content of the A nucleus. AUTHORS.

1573. Production of N^{13}. R. B. Roberts and N. P. Heydenburg. *Phys. Rev.* 53. *pp.* 374–378, *March* 1, 1938.—The reactions $C^{12} + H^1 \rightarrow N^{13} + h\nu$ and $C^{12} + H^2 \rightarrow N^{13} + n^1$ have been studied and the absolute yield of positrons measured for various voltages. The proton-capture reaction shows a single resonance of 30 kV half-width at 450 kV. This resonance has been compared with the similar Li resonance to fit it into the voltage scale of the Li and F resonances. Comparison of the positron yields of the two reactions permits a calculation of the yield of N^{13} in the proton reaction from the yield of neutrons in the deuteron reaction as measured by Amaldi, Hafstad, and Tuve [see Abstract 2886 (1937)]. The yield thus determined is approximately 7·5 times higher than the previously accepted value based on positron measurements, and corresponds to a total reaction cross-section of about $8\cdot 4 \times 10^{-24}$ volt cm^2. However, the observed number of positrons from the deuteron reaction, obtained by comparison with uranium, is 2·5 times less than the number of neutrons from the same reaction. This discrepancy could be explained by K-electron capture by the N^{13} nucleus, but the errors involved are too uncertain to say definitely that this process does occur. An unsuccessful attempt was made to observe scattering of protons by C at the resonance voltage. [See also Abstract 4442 (1936)]. AUTHORS.

1574. Disintegration of Nuclei by Cosmic Rays. A. Filippov, A. Gdanow and I. Gurevich. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 181–183, 1938. *In English.*—Using photographic plates impregnated with Li and B compounds, records are obtained of tracks of heavy particles liberated by cosmic rays at sea-level. The greatest length of single tracks was 304 cm. in air at S.T.P. corresponding to kinetic energies of 17 eMV or 68 eMV according as the tracks are those of protons or of α-particles. Groups of tracks, heavy particles and showers, are also observed and interpreted in various ways. The specific ionisation indicates that some of the particles have masses lying between 180 m_0 and 800 m_0, where m_0 is the rest mass of an electron. F. C. C.

1575. Artificial Radioactivity Produced by Cosmic Rays in Lead and Iron. J. Clay and K. H. J. Jonker. *Physica*, 5. *pp.* 171–174, *March*, 1938. *In English.*—A counter is surrounded by lead and the variation is observed directly after covering it with a layer of 20 cm. Pb. The experiment was repeated 10 times and the time for 3 × 100 shocks recorded. The theoretical deviation to be expected is 1·8%, the experimental mean deviation was 1·05%. After covering and uncovering, a deviation of 10% was found. With iron the deviation was 6%. AUTHORS.

1576. Intensities of the Principal Conversion Electron Rays of the Active Deposit of Thoron and the Photographic Efficiency of Electrons. R. Arnoult. *Comptes Rendus*, 205. *pp.* 1380–1382, *Dec.* 27, 1937.—The intensities of β-rays of different energies produced by internal conversion of γ-rays were measured photographically and also directly with the aid of Geiger-Müller counters. The available apparatus limited the measurements to β-rays of energy less than 300 ekV. The power of the source of radiation, active deposit of thoron, was determined by comparing its γ-radiation with that of a Ra standard. The results for the photographic efficiency agree well with those of Ellis and Aston in the common range of electron energies. Ilford X-ray plates were used. W. S. S.

1577. Low Energy Region of the β Spectrum of RaE. A. I. Alichanian and A. S. Zavelskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 9. *pp.* 467–468, 1937. *In English.*—More accurate values of the distribution curve in the low energy region of the β-spectrum of RaE were obtained by employing a window covered with acetyl cellulose of thickness approximately 1 μ. The results agree with theory more nearly than was supposed, but for energies below 100 kW there is a divergence not yet accounted for. [See following Abstract.]. H. G. C.

1578. Low Energy Region of the β Spectra of ThB″ and ThB. A. I. Alichanian and A. S. Zavelskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 17. 9. *pp.* 469–470, 1937. *In English.*—The distribution of these spectra with theory agrees up to the lowest limits supporting the conclusion that the anomaly in the case of RaE [see preceding Abstract] is due to the β-disintegration of RaE being a forbidden transition. H. G. C.

1579. Amplitude Factor in β-Decay. K. Umeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 750. *pp.* 137–143, *Jan.*, 1938. *In German.*—The author considers three forms of the amplitude factor introduced by Camp [see Abstract 3512 (1937)], into the Fermi β-decay matrix, in order to represent the known shape of the reciprocal action potential function between protons and neutrons It is noticed that the induced β-decay can contribute more to the absorption of a light quantum of very high energy in matter than can pair production. With the introduction of the amplitude factor, the probability of the induced β-decay does not increase unlimitedly as formerly, but it has a finite maximum and vanishes for an infinitely large energy of the light quantum. G. O. B.

1580. Spin Change in the Radioactive β-Decay of ^{87}Rb into ^{87}Sr. M. Heyden and H. Kopfermann. *Zeits. f. Physik,* 108. 3–4. *pp.* 232–243, 1938.—Accurate measurements of the hyperfine structure of the spectrum of pure ^{87}Sr yield a spin of 9/2 and a magnetic moment of $-1 \cdot 1$ nuclear magnetons. This means that in the decay of Rb into Sr the nuclear spin has to change by 3 units. This may account for the extremely long life-time of Rb. R. P.

1581. Complete Detection of β-Particles. S. C. Curran. *Phil. Mag.* 25. *pp.* 393–416, *March,* 1938.—A comparison of the performance of a Geiger point counter with reversed potentials is made and it is shown that for complete detection, it is preferable for the case to be negative with respect to the point. The form and magnitude of the impulses, the variation in efficiency with the pressure and the path of the ray in the counter, and the shape of the count-voltage characteristic curves for different tubes are analysed. From consideration of the difference in the two methods of operating the tubes, the conditions to be fulfilled for high efficiency in detection are deduced. Finally, the mode of action of the tube is discussed and experiments are cited which show that the action of the counter with the point negative is to be explained in terms of secondary emission rather than by the production of ionisation by collision in the gas. F. C. C.

1582. Absorption of Radium γ-Rays. G. J. Sizoo and H. Willemsen. *Physica,* 5. *pp.* 100–104, *Feb.*, 1938. *In English.*—From the theory of Klein and Nishina on the scattering, that of Hulme and others on the photo-absorption and that of Bethe and Heitler on the creation of pairs, the total absorption coefficients for the wave-lengths corresponding to the various components of the γ-radiation of Ra are calculated. With the aid of these theoretical absorption coefficients and of the intensities of these components found by Ellis and Aston the absorption curves for Al, Fe, Cu, Sn and Pb are calculated. The results of these calculations are found to be in perfect agreement with the absorption measurements of Kohlrausch [see Abstracts 780 (1918) and 310 (1919).] AUTHORS.

1583. Production of γ-Rays by Neutrons. E. H. S. Burhop, R. D. Hill and A. A. Townsend. *Roy. Soc., Proc.* 165*A*. *pp.* 116–132, *March* 18, 1938.—Measurements have been made of the absorption in B of those neutrons which excite γ-rays in specimens of Cd, Ag (of two thicknesses), As, Sb, I and Hg. The measurements were carried out using thermal neutrons in the case of Cd and Ag (thin specimen) and non-thermal neutrons in the case of Ag, As, Sb and Hg. The curves in the latter case were always of the same general type, consisting of an initial component rapidly decreasing with B absorber thickness superimposed on a component varying very slowly with B thickness. It is shown that the initial component is to be associated with a nuclear resonance level corresponding to very small neutron energy, while the other component is due to neutrons captured into resonance levels of greater energy. The curves are interpreted in terms of the Bethe-Placzek formulation of Bohr's theory of nuclei. In the case of Ag, absorption measurements in B have in addition been made of those neutrons which excite the β-radiations of 22 sec. and 138 sec. half-period. The question of whether a nucleus which on neutron capture can emit both β- and γ-radiation will have the same resonance levels corresponding to both methods of reorganisation is discussed. For Ag the evidence points to the existence of separate sets of energy levels for γ-ray emission and β-ray decay, but it is not sufficiently conclusive to settle finally this point. AUTHORS.

See also Abstracts 1367, 1368, 1565.

RADIATION.

COLORIMETRY.

1584. Colour of Outdoor Photographic Subjects. F. H. G. Pitt and E. W. H. Selwyn. *Kodak Research Lab. Comm. No. H.*641. *Phot. J.* 78. *pp.* 115–121 ; *Disc.*, 126–128, *March*, 1938.—Measurements have been made, on a tri-colorimeter designed for the purpose, of the colour of the total light reflected into a camera lens by a number of outdoor photographic subjects. It has been found that this colour is representable on the average by a colour temperature of 4800° K. and that none of the subjects departs markedly from this, although components of the subjects such as grass and sky are some way removed from white. The over-all colour remains the same during the whole of the day, except towards sunset, when the light rapidly becomes more blue. These results are discussed briefly with respect to the measurement of film speeds. AUTHORS.

1585. Colour Charts in Photography. E. R. Davies and E. W. H. Selwyn. *Kodak Research Lab. Comm. No. H.*634. *Phot. J.* 78. *pp.* 122–126 ; *Disc.*, 126–128, *March*, 1938.—It is shown that the average ordinate of the colour reproduction curve obtained on a Lagorio chart is independent of the illuminant or colour sensitivity of the photographic material. In consequence of this, it must be concluded that with orthochromatic material exact equality of visual and photographic reflection factors is impossible for every colour—even those within the range to which the orthochromatic material is sensitive. This applies whatever filter is used. AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1586. Magnetic Birefringence of Solutions of Pinenes in Benzene. J. Rabinovitch. *Comptes Rendus*, 206. *pp.* 342–344, *Jan.* 31, 1938.—Measurements of the magnetic birefringence of solutions of pinenes in benzene confirm that mixtures of benzene and β-pinene, in contrast to those of benzene and α-pinene, contain a third component which is a product of molecular association. C. B. A.

V.
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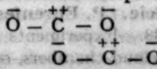
1587. Magnetic Birefringence of Aromatic Compounds in the Molten State. W. J. John. *Faraday Soc., Trans.* 34. *pp.* 275–278, *Feb.*, 1938.—Following on Chinchalkar and Mahajan's work [see Abstract 5098 (1936)] the magnetic birefringence of several simple aromatic compounds have been studied in the molten state. The apparatus used is the same as that employed by Chinchalkar for solutions with suitable modifications for melting the substance and keeping it at constant temperature (up to 100° C.). The results are tabulated and discussed. The values of the molar birefringence C_M relative to benzene support the conclusions drawn by Chinchalkar and Mahajan from their experiments on solutions regarding the structure of molecules and give information concerning the relative positions of the benzene rings. R. L.

1588. Magnetic Double Refraction of Organic Liquids and their Vapours. H. König. *Ann. d. Physik,* 31. 4. *pp.* 289–314, *Feb.*, 1938.—The magnetic double refraction of benzene vapour is studied at 1–45 atm. pressure. Its Cotton-Mouton constant has a mean value of $C = 2 \cdot 5 \times 10^{-5} \pm 6\%$ at 90° C. and 760 mm. Hg. The constant of liquid benzene is measured between 15·5 and 58·2° C. Details are given of the apparatus used and a theoretical discussion of the results is included. The variation with temperature of the constant for liquid benzene is accounted for better by the orientation theory than is the case for the Kerr constant. The molecular reciprocal actions in liquid benzene are smaller for magnetic double refraction than for electrical. An explanation is advanced. The C.M. constant of nitrobenzene vapour is immeasurably small; its molecular C.M. constant is smaller than the molecular constant of the liquid. The variation of magnetic and electrical double refraction with temperature is compared and also the results for solutions. The large decrease of Kerr constant at the transition from gas to liquid is accounted for by the dipole equation of the Kerr effect, while the optic anisotropy accounts for the magnitude of the C.M. constant. R. L.

***1589. Electric Kerr Effect in Liquid and Gaseous CO_2. L. H. Borchert.** *Phys. Zeits.* 39. *pp.* 156–166, *Feb.* 15, 1938.—An apparatus is described with which the Kerr effect of compressed gases can be measured. Measurements on liquid and gaseous CO_2 show that in the gaseous state above the critical temperature the Langevin molecular orientation theory can be applied to the observations of the density up to the critical density. Further it is shown that in the liquid state in the neighbourhood of the critical density the deviations are very small, of the order of 10%. With increasing density and decreasing temperature the deviations become greater in the liquid and the gaseous state; this is connected with the molecular state due to the closer packing and the consequent anisotropy of the internal field. The nature of the deviations in the neighbourhood of the critical point indicates the presence of a second effect, a complex formation of the type 

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. R. L.

1590. Ultra-Violet Absorption Bands of Ethyl Alcohol, *n*-Propyl Alcohol, and *n*-Butyl Alcohol in Relation to Magneto-Optical Dispersion. W. J. G. Beynon. *Phil. Mag.* 25. *pp.* 443–455, *March,* 1938.—The u.v. absorption spectra of the vapours were photographed down to approximately 650 Å, and the vapours of all three liquids exhibit one diffuse band, together with a region of absorption below 700 Å. Full data for wave-lengths, refractive indices, and calculated and observed values of Verdet's constant are tabulated. Formulæ involving the absorption bands are given for the magneto-optical dispersions of the three liquids from $0\cdot67$ to $\cdot30\,\mu$. In the case of ethyl and *n*-butyl alcohols the formulæ apply up to $1\cdot0\,\mu$, but above this the magnetic rotation is influenced by infra-red absorption bands to an extent which is, however, very slight compared with that of the extreme u.v. bands even up to $2\cdot0\,\mu$. N. M. B.

1591. Ultra-Violet Absorption Bands of Methyl Alcohol and Allyl Alcohol and their Relation to Magneto-Optical Dispersion. W. J. G. Beynon and E. J. Evans. *Phil. Mag.* 25. *pp.* 476–488, *March,* 1938.—The absorption spectra of the vapours were photographed over the region 1850 to 600 Å. Methyl alcohol exhibits absorption bands centred at 1588 and 1470 Å, with a further region of absorption around 650 Å. Allyl alcohol exhibits two broad absorption bands centred approximately at 1650 and 750 Å. Full data for wave-lengths, refractive indices, and calculated and observed values of Verdet's constant are tabulated. Formulæ involving the absorption bands are given for the magneto-optical dispersion. N. M. B.

EMISSION.

1592. Table of Planck's Function from 3500 to 8000° K. P. Moon. *J. Math. Phys.* 16. *pp.* 133–157, *Dec.,* 1937.

***1593. Cosmic-Ray Recorders. A. Dauvillier.** *Bull. Astronomique,* 10. 3–4. *pp.* 123–138, 1937.—The apparatus installed at the Paris Observatory since the creation of the Cosmic Physics Laboratory in 1935 is described. The low sensitivity and high parasitic ionisation of the Kolhörster type of ionisation chamber are avoided by using pure Xe and A at 100 atm. in duralumin cylinders. A linear response, with saturation at 150 V, is obtained. Four instruments are described. (1) A leakage apparatus employs an isolated charged central electrode whose potential is measured as a function of time by an electrometer. The position of the electrometer needle is recorded on a kinematograph film moving at 1 cm./hr., the charge being automatically replenished at regular intervals. The apparatus can be left unattended for a week. (2) A cosmic ray intensitometer continuously measures and records, by means of an electrometer, the ionisation current leaking through a high resistance of the Bronson type. This instrument has been used for studying the barometric effect and Hoffmann " bursts". (3) Another intensitometer dispenses with the electrometer and radioactive leak in favour of photoelectric means of measurement. (4) A non-magnetic ionisation chamber is intended for the spectroscopy of cosmic rays by studying its response as a function of the magnetic field in which it is placed. A. Hu.

1594. Cosmic-Ray Cloud Chamber Photographs, and Evidence for Heavy Particle. P. Ehrenfest, Jr. *Comptes Rendus,* 206. *pp.* 428–430, *Feb.* 7, 1938.—Experiments were made with a counter-controlled assembly of two cloud-chambers, one above the other, in a magnetic field of 10000–15000 gauss. A 5 cm. block of Pb was placed over the top chamber, and a 9 cm. block between the two chambers. A photograph is recorded which shows a shower of five particles in the lower chamber, originated by a highly energetic particle which has traversed the full 14 cm. of Pb and emerges from among the shower-particles with relatively little loss of energy, the track being little deviated by the field. Another exposure shows a heavy track in the upper chamber which from a consideration of its ionisation and $H\rho$ is attributed to a particle of about 200 times electronic mass. D. H. F.

1595. Variation of Cosmic-Ray Ionisation with Chamber Pressure. B. Vinzelberg. *Zeits. f. Physik,* 108. 3–4. *pp.* 171–182, 1938.—Cosmic-ray ionisation was measured in an air-filled chamber over a pressure-range of 1–37 atmospheres. The presence of a primary radiation of high energy, and a secondary radiation of low energy originating in the walls of the chamber, is demonstrated; due consideration is given to the residual ionisation. The course of the variation with pressure for cosmic radiation differs from that for γ-radiation over this range. Absorbing screens of Pb, Al and Fe inside the chamber produce secondary rays of low energy, the ionisation curves being different for the different materials. D. H. F.

1596. Proportion of Electrons to Photons in Cosmic-Ray Showers. H. Geiger and O. Zeiller. *Zeits. f. Physik,* 108. 3–4. *pp.* 212–217, 1938.—From coincidence counts with three different assemblies of counters under a sheet of Pb, it is shown, from a comparison of counting rates of various groups of counters in each assembly, that a shower contains a relatively intense and strongly diffused photon-component. It is estimated that for each electron in a shower about 50 photons are present on the average. D. H. F.

1597. Cosmic-Ray Intensities at Great Depths. V. C. Wilson. *Phys. Rev.* 53. *pp.* 337–343, *March* 1, 1938.—A fourfold Geiger-Müller tube telescope was employed to count the relative number of cosmic rays under different thicknesses of rock. Each Geiger-Müller tube consisted of a 0·125 mm. W wire anode and a cylindrical Cu kathode 9 cm. in dia. and 71 cm. in length sealed in a glass envelope filled with H_2 to a pressure of 9·6 cm. of Hg. The experiment was performed in a mine whose shaft was inclined at an angle of 34° from the horizontal. Counts were made at thirty-nine different stations at depths from zero to 1408 m. of water equivalent, where the rate was $5 \cdot 7 \times 10^{-5}$ as great as at the surface. When the intensity is plotted against the depth, the resulting curve shows no points of inflection. The effective absorption coefficient decreases from 0·07 per m. of water at the surface to 0·0025 at the greatest depth. If the logarithm of the intensity is plotted against the logarithm of the depth, two straight lines, one from 20 to 250 and the other from 250 to 1418 m. water equivalent from the top of the atmosphere, represent the data well. Shower counts were also made at ten of the stations. These also show a bend at 250 m. This suggests that there may be two types of very penetrating rays both capable of producing showers. It may be that one of these consists of " heavy electrons " and the other of " neutrinos." AUTHOR.

1598. Nature of the Penetrating Component of Cosmic Rays. P. M. S. Blackett. *Roy. Soc., Proc.* 165*A*. *pp.* 11–31, *March* 18, 1938.—Further measurements of the energy loss of cosmic rays in metal plates have confirmed the former results of Blackett and Wilson [see Abstract 3071 (1937)], that very nearly all the rays with $E < 2 \times 10^8$ eV are apparently electronic in character. A reinterpretation of the data for higher energies, where the mean loss is quite small, in the light of the cascade theory of showers, has confirmed the conclusion of Neddermeyer and Anderson [see Abstract 3069 (1937)] that there are probably present a few energetic, but absorbable, rays which can be identified with fully radiating electrons. The penetrating rays, which at sea-level are in a large majority, cannot therefore be normal electrons. It is shown by indirect argument from the spectrum, and by direct experiment, that these penetrating rays become indistinguishable from electrons when their energy falls much below 2×10^8 eV. It is pointed out that the main requirement of a theory of the penetrating component is to explain this striking property. Various possible theories are discussed, and it is shown that there are two main types of possible explanation. The first is that the particles are heavy when energetic, but change their mass suddenly, during collisions with nuclear fields, perhaps through some type of resonance effect, when their energy falls below a critical energy. The second is that in which the penetrating rays are supposed to have the electronic rest mass, but are distinguishable from normal electrons by some unknown property which has the effect of making their radiative energy loss vary with their energy and the absorber, in a way rather similar to that given by the various theories previously put forward to explain the then supposed suppression of the radiation loss of normal electrons. Further experiments will be required to distinguish between these possibilities. AUTHOR.

***1599. Light Source with Constant Energy in the Range of Visible Wave-Lengths. M. v. Ardenne.** *Zeits. f. techn. Physik*, 19. 2. *pp.* 41–43, 1938.—An apparatus using a fluorescent screen excited by long wave-length ultra-violet, the intensity being governed by a luxmeter is described. It gives constant intensity between 460 and 660 mμ. A. J. M.

1600. Radiation Emitted on Friction of Solid Dielectrics F. Perrier. *Comptes Rendus*, 206. *pp.* 107–109, *Jan.* 10, 1938.—Further experiments, with amber, ebonite, sulphur, and paraffin as dielectrics, are described in support of the author's view [see Abstracts 2678 and 4170 (1937)] that the discharge of a dielectric electrified by friction is accompanied by a radiation which ionises the surrounding gas. The absorptions in air of such radiation from the above dielectrics are respectively 2–6, 6–10, 3–10 and 13–17 (cm.$^{-1}$). C. A. S.

See also Abstracts 1368, 1545, 1574, 1575, 1741.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

1601. Photosensitising Action and the Fluorescence of Uranium Salts. J. Weiss. *Faraday Soc., Trans.* 34. *pp.* 451–456, *March*, 1938.—The hypothesis of collisions of the second kind being responsible for the quenching of the fluorescence of uranium salts in solution does not agree with experimental facts. The elementary process of quenching—which is identical with the primary process in the photosensitised reactions—consists in an electron transfer (resonance transfer) from the quenching molecule (acceptor) to the excited uranium ion. The quenching of the uranium fluorescence by I$^-$ and (in the presence of molecular oxygen) the photosensitised formation of I$_2$, and the sensitised photolysis of formate lactate and oxalate are discussed, and the experimental facts are found to be in quantitative agreement with the above theory. The theory also accounts for the rather peculiar effects observed under conditions when both I$^-$ ions and oxalate are present, which have hitherto not been explained satisfactorily. AUTHOR.

1602. Kinetics of Phosphorescence. D. Blochinzew. *Phys. Zeits. d. Sowjetunion*, 12. 5. *pp.* 586–601, 1937. *In German.*—It is claimed that existing experimental results show that the emission of light from Lenard phosphors indicates a bimolecular reaction—the recombination of electrons and ions. It is shown that such a reaction cannot disturb the thermal equilibrium of the free electrons. The explanation of the actual decay curves lies in the existence of a number of bimolecular reactions of differing velocities. An estimation of the time of recombination of ions and electrons is attempted. J. E.

1603. Luminescence in the Cold Oxidation of Phosphorus and the Energy of Dissociation of PO. K. Rumpf. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 469–473, 1938.—A number of bands is found in the " continuum " of the visible spectrum of the luminescence accompanying the cold oxidation of P. From their relation to the u.v. part of the spectrum, the bands are ascribed to PO. The energy of dissociation of PO is found to be about 6·2 V. L. A. W.

1604. Kathodeluminescence of Calcium Silicate. E. Iwase and S. Iimori. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 753. *pp.* 173–181, *Jan.*, 1938. *In English.*—It has been found that the yellow luminescence of Japanese Wollastonite is due to the presence of Mn. The Mn content of Wollastonite and of Pectolite has been determined. Synthetic calcium silicates have been prepared showing similar luminescent spectra to those of the natural minerals. J. E.

1605. Active Nitrogen. D. B. McNeill. *Phil. Mag.* 25. *pp.* 471–475, *March*, 1938.—Experiments with nitrogen discharge-tubes are described which illustrate the large effect that can be produced by traces of impurity. The bearing of these observations on the problem of active nitrogen is mentioned. The persistence of the NH band spectrum is correlated tentatively with the existence of a stable ion NH$^-$. An electrical mechanism is suggested for the production of the negative nitrogen bands in the auroral nitrogen afterglow. AUTHOR

See also Abstract 1703.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1606. Non-Ideal Lloyd's Mirror in Wide-Angle Interference. F. W. Doermann. *Phys. Rev.* 53. *pp.* 420–425, *March* 1, 1938.—The paper is an extension of an earlier article on the wide-angle interference of multipole radiation [see Abstract 5302 (1937)]. Non-ideal reflections are here taken into account and the theory is applied to the Lloyd's mirror arrangement using a material point source composed of electric or magnetic dipoles, quadrupoles, or octopoles. Qualitatively the earlier results are not appreciably altered; quantitatively it is found that the ideal treatment gives satisfactory results for non-ideal metallic mirrors only for divergent beams making an angle greater than about 90°. AUTHOR.

1607. Optical Determination of Composition of Mixtures of Vapours and Air. W. Kinder. *Zeits. f. techn. Physik,* 19. 2. *pp.* 43–47, 1938.—Four experiments are described by which the concentration of vapours mixed with air can be determined, in three cases by the use of a gas interferometer, and in the fourth by photometric examination of the absorption spectrum. The vapours used were ether, C_2H_5OH, benzine, C_6H_6, hexane, CS_2, and toluene. A. J. M.

1608. Effect of Width of Slit on Fraunhofer's Diffraction Phenomenon. D. Onoyama. *Hirosima Journ. Sci.* 8. *pp.* 81–85, *Feb.*, 1938. *In English.*—In the ordinary Fraunhofer's diffraction of light phenomenon through a number of parallel slits it is well known that subsidiary maxima fewer by two than the number of slits are seen between the two principal maxima. In the present experiment it was found that the number of subsidiary maxima diminishes, one by one, as the width of the slits is gradually broadened. The exact investigation of this phenomenon is given. AUTHOR.

1609. Light-Scattering and Allied Properties of H_2O and D_2O. S. Bhagavantam and B. S. R. Rao. *Indian Acad. Sci. Proc. 7A. pp.* 35–37, *Jan.*, 1938.—In order to compare the intensities of the transversely scattered light in H_2O and D_2O, the adiabatic compressibility and depolarisation have been measured at the laboratory temperature. The isothermal compressibility is calculated with the help of the thermodynamic relation and the figures show that the relative scattering powers of D_2O and H_2O should be as 1·8 : 2. This is in good agreement with the ratio obtained experimentally by photographing the tracks of the transversely scattered light using the λ 4358 radiation from a mercury point source lamp. Ratio of β_r to β_φ in D_2O is very nearly unity as in the case of H_2O. AUTHORS.

1610. Structure of the Rayleigh Scattering in Liquids. K. Birus. *Phys. Zeits.* 39. *pp.* 80–90, *Jan.* 15, 1938.—After a résumé of previous work the author describes new experiments made with an apparatus of the Wood type. The fine-structure was examined with an echelon grating of 33 plates, allowing a resolving power of 500,000 in the violet to be attained. The author finds (1) that the coherent light scattered by the density fluctuations is perfectly linearly polarised when one observes perpendicularly to the incident beam. Besides the "heat-wave doublet" there is a fraction of light of unmodified frequency, whose magnitude appears to depend upon the ratio Cp/Cv of the specific heats. The doublet and the unmodified line together form a triplet, whose intensities are in the ratio $Cv/2 : (Cp\text{-}Cv) : Cv/2$, as required by Landau and Placzek. (2) The depolarised part of the scattered light, the "anisotropy scattering," contains no light of unmodified frequency. It accounts for the broadening of the Rayleigh line. The half-value width is at least 1 cm^{-1}.
A. C. M.

1611. Scattering of Light by Crystals. E. Gross. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 2. *pp.* 93–94, 1938. *In English.*—Recent experiments indicate that the Rayleigh line in light scattered by crystalline quartz has six modified components, three being on each side of the undisplaced line. In the case of light scattered by liquids, the two modified components are produced by Debye's longitudinal heat waves. In the case of crystals the six modified components are attributed to scattering by two kinds of transverse waves as well as by longitudinal waves. It is suggested that the shearing strains distributed periodically along the transverse heat wave trains cause local variations of the index of refraction, and, as in the case of longitudinal heat waves, the scattering of light may be interpreted as the reflection from the spatial lattices produced by the transverse heat wave trains. This conclusion is supported by the fact that the diffraction of light by supersonic waves and the scattering of light by Debye's elastic heat waves are phenomena of similar nature. K. M. C.

See also Abstracts 1576, 1622, 1623.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1612. Photolysis of Acetone in Presence of Hydrogen. H. S. Taylor and C. Rosenblum. *J. Chem. Phys.* 6. *pp.* 119–123, *March*, 1938.—The photodecomposition of acetone in presence and absence of H_2 with light of wave-length > 2500 Å has been studied at temperatures from 70 to 300° C. Up to 160° C. acetone alone yields negligible amounts of methane and ethane is the hydrocarbon predominantly produced. The proportion of methane increases rapidly with temperature, the activation energy of its formation in acetone being 8·6 kg.cal. In presence of H_2 methane formation is negligible at 70° C., is marked at 160° C. and increases rapidly with temperature with an activation energy of this increase equal to 6·4 kg.cal. At 300° C. it represents 75% of the ethane-methane product, which shows that photodissociation to methyl radicals is the major, if not exclusive primary process. Analysis of the data indicates that ethane formation is either a wall reaction with zero activation energy or a bimolecular association process of small activation energy. A decrease in ethane formation with increase of temperature is ascribed to a decrease in the stationary state concentration of methyl radicals. An activation energy of the reaction $CH_3 + H_2 = CH_4 + H$ equal to 11 ± 2 kg.cal. has been deduced. A mechanism to account for quantum yields less than unity in the low temperature range, consistent with primary dissociation into radicals, has been suggested. [See also Abstract 2556 (1937).] AUTHORS.

1613. Contrast of Photographic Positive Papers. J. Bontenbal. *Phot. J.* 78. *pp.* 76–88, *Feb.*, 1938.—A survey is made of the different standards used for expressing the contrast of photographic papers. An attempt is made, on the basis of the form of the characteristic curve, to determine which standard indicates the contrast most reasonably. Having decided on a standard the correctness of this is investigated by means of a statistical investigation. A. H.

1614. Sensitometric Investigations. W. Seifert. *Zeits. f. wiss. Phot.* 37. *pp.* 5–9, *Jan.–Feb.*, 1938.—A brief summary is given of investigations carried out in 1921–1925, with materials then current, on the form of the reproduction-curve with various combinations of negative and positive materials. Three constants suffice to describe the form of a given characteristic curve obtained with a given developer, *viz.*, gamma-infinity, projected length of the straight part of the curve and the ratio D/γ—decribed as the " softness " or " footiness " of the curve—where D is the density corresponding to the inertia point of the material. The slope of the curve at this value of log E, divided by gamma, gave a constant (0·46) for all the materials studied. L. V. C.

1615. Nature of Silver Photo-Halides and their Relation to the Latent Photographic Image. H. Socher. *Zeits. f. wiss. Phot.* 37. *pp.* 51–72, *March*, 1938.—Investigates the theoretical and experimental bases for work on the question of the nature of the photohalides and of the substance of the latent image, describing the necessary analytical method. The balance between separated reduction and oxydation materials, and free photochloride, AgBr and photobromide, as well as Ag and photobromide, and emulsionised AgBr suspended in gelatin was examined for unilluminated, illuminated and developed conditions. It is concluded from the results obtained that photohalides and the latent image material present a two-phase mixture of silver halide and Ag. In the presence of gelatin, conditions upsetting the equilibrium are to be observed, for which the

postulation of an increased solubility of finely divided Ag or an influence of the gelatin on the solubility of silver halide is an insufficient explanation.
R. C. F.

1616. Theory of Colour Photography. Part I. H. Frieser and R. Reuther. *Zeits. f. techn. Physik*, 19. 3. *pp.* 77–85, 1938.—Considers theoretically the ideal conditions for subtractive colour photography, and the optimum conditions, using dyes which are actually obtainable. It is concluded that a true colour reproduction is only possible if optimum dyes with non-overlapping absorption regions are used. With absorption regions which are in contact a true colour and brightness reproduction with decreased saturation is possible, Should the regions not touch then only true colour reproduction is obtained. A true colour reproduction for grey is obtainable with commercial colours. Work on the subtractive mixing of colours leads to the construction of a colour excitation body utilising subtractive reproducing dyes. Useful conclusions for the selection of reproducing dyes, the viewing filters and the gradation of the positive, are obtained from the excitation measurement calculations. R. C. F.

***1617. Studio Photography. A. v. Lagorio.** *V.D.I.* 82. *pp.* 283–288, *March* 5, 1938.—Describes the present state of the development of apparatus for film studio photography in Germany, dealing with the film camera recently developed to replace the French cameras previously used, stationary and transportable tripods, lighting apparatus, measurement of scene illumination, and developing machines. R. C. F.

1618. Surface Quality of Photographic Paper. A. Narath. *Zeits. f. techn. Physik*, 19. 2. *pp.* 36–41, 1938.—A distinction is drawn between the R.L. of a photographic layer (which is concerned with elements of the surface) and the surface quality (which is concerned with the surface as a whole). The effect of diffraction and diffusion in the photographic emulsion when an image of a rectangular slit is formed on a photographic paper is discussed. Under certain conditions, due to the " inner diffraction effect," the image of the slit is smaller than its geometrical-optical size and this phenomenon is greater in papers than in films and plates. For Agfa-Lupex paper, a maximum diminution of 35 μ is observed, whilst for plates and films it is about 9 μ. An account is given of measurements on Agfa-Lupex papers of various grades and the significance of the results, particularly in regard to their bearing on sound film recording, is emphasised.
H. J. H. S.

See also Abstracts 1563, 1584, 1585.

PHOTOMETRY.

1619. Photometric Invariant. A. A. Geršun. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 1. *pp.* 31–32, 1938. *In English.*—It is shown that if there be a layer of material sandwiched between two other media of refractive index n and n', then if τ be the coefficient of transmitting capacity of the layer to diffused light entering from the first medium, and τ' that for the second medium, then $n^2\tau = n'^2\tau'$. If the layer is reduced to the interface between the two media and ρ is the coefficient of diffused light reflection by the interface for light coming from the first medium, and ρ' that for light falling on the interface from the second medium, then $n^2(1 - \rho) = n'^2(1 - \rho')$. A. H.

***1620. Portable Photoelectric Illumination Meter. J. S. Preston.** *Journ. Sci. Instruments*, 15. *pp.* 102–105, *March*, 1938.—This paper describes a photoelectric illumination meter using the emission

type of photo-cell with valve amplification. Simplifications are introduced in the electrical circuit with a view to simplicity and compactness. The instrument is capable of measuring illuminations as low as $0 \cdot 005$ f.c. to an accuracy of ± 1%. The instrument consists of two separate units connected by a flexible cable, enabling the test surface to be placed in any desired position. Although designed as a portable instrument, the meter is in every way suitable for laboratory precision measurements.
AUTHOR.

POLARISATION.

1621. Ellipticity of Light Reflected from Thin Films of Oriented Molecules. H. A. McTaggart. *Roy. Soc. Canada, Trans.* 31. *Sect.III. pp.* 141–151, *May*, 1937.—The discussion calls attention to the changes produced in the ellipticity of the light reflected from a number of monolayers of barium stearate placed on glass. A complete theory based on the ordinary laws of reflection and refraction at such surfaces would be necessarily a complicated one. Two experimental facts may be emphasised in cases where the incident light is plane polarised. (1) Films built up of oriented molecules on glass may be used to vary the ellipticity —from positive to negative values—of light reflected from them. (2) Certain thicknesses of film may be found which give plane polarised light at all angles of incidence. The source of light used in making the measurements was a 6-V tungsten bulb of small design with a Wratten filter for green light. The light transmitted was not monochromatic but colour effects were perceptible only when the film reached a thickness of about 100 layers or more. It is intended to repeat some of the readings with a more strictly monochromatic light as soon as possible. AUTHOR.

1622. Depolarisation of Light Scattered in Solutions of Electrolytes. K. Hogrebe. *Phys. Zeits.* 39. *pp.* 23–36, *Jan.* 1, 1938.—The normal cruciform type of apparatus was employed, and the light from an arc lamp was focused on the centre of a flask. The light scattered at right-angles was received on a photographic plate, after passage through a Glan-Thomson prism, so that two spots were obtained corresponding to the two different directions of polarisation. Solutions of different concentrations of the chlorides, sulphates, nitrates of Na, K and NH_4 were investigated. It was concluded that the depolarisation is only greatly increased if one of the ions is asymmetric. A slight change in the depolarisation with isotropic ions is attributed to an effect of them on the water molecules. The substances used were strongly dissociated. A. C. M.

1623. Reciprocity Theorem in Colloid Optics. R. S. Krishnan. *Indian Acad. Sci., Proc.* 7*A. pp.* 21–34, *Jan.*, 1938.—Earlier work on depolarisation on scattering [see Abstracts 3530 and 4008 (1937)] is continued. The reciprocity relation, $\rho_u = (1 + 1/\rho_h)/(1 + 1/\rho_v)$, connecting the three depolarisation factors for transverse scattering is deduced theoretically, and it is pointed out that the relation is valid only for a solution containing a large number of particles having no preferred orientation. Various deductions are tested experimentally with satisfactory results. A. H.

1624. Reflection of Circularly Polarised Light by Certain Coleoptera. J. P. Mathieu and N. Faraggi. *Comptes Rendus*, 205. *pp.* 1378–1380, *Dec.* 27, 1937.—When illuminated with natural white light, the teguments of certain beetles reflect coloured light which is sometimes circularly polarised. For two kinds of beetle showing the latter effect measurements were made of the phase difference, after reflection, between the principal components of linearly polarised incident light, for different angles of incidence and different wave-lengths of the light. The light transmitted by the tegument was also studied and the existence of rotatory power and circular dichroism established. Interpreting the results, the authors attribute the circular dichroism to selective reflection of one of the circularly polarised components. W. S. S.

1625. Dependence of Photodichroism of Bleached Colour Layers on the Illumination. G. Ungar. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 427–440, 1938.—The Weigert effect is attributed to the optical anisotropy of light-sensitive dye molecules. On the assumption that the molecules in the unilluminated film are statistically distributed over all orientations, formulæ are deduced for the dependence of the dichroism on the illumination and on the dichroism of the dye molecules. These formulæ are only strictly valid for dyes whose molecules are optically uniaxial, but it may be assumed that they also represent the photodichroism of triaxial molecules approximately. C. B. A.

1626. Solvent Action on Optical Rotatory Power. Part II. Quadrupole Field of the CS_2 Type Molecule. K. Cohen and C. O. Beckmann. *J. Chem. Phys.* 6. *pp.* 163–167, *March*, 1938.—The applications of the general expression for the vectorial solvent field in organic liquids are further extended by detailed consideration of quadrupole molecules of the types CS_2. The results of the computation are found satisfying from a theoretical standpoint. The experimental control is undertaken with the aid of a previously developed theory of optical rotatory power in solution. The results are found to be in accord with the existing data. [For Part I see Abstract 638 (1937).] AUTHORS.

***1627. Quartz Rotatory Compensator of High Accuracy. A. Ehringhaus.** *Zeits. f. Krist.* 98. 5–6. *pp.* 394–406, 1938.—For the measurement of the path difference of doubly refracting crystal plates in polarised light between cross nicols the Babinet or Soleil-Babinet compensators may be used. If a kalkspar plate, 0·1 mm. thick, cut perpendicular to the optic axis is rotated from a position perpendicular to the light to a position making an agle 30° with this direction, the path difference for Na light changes from 0 to 4λ. The thin quartz plate of Nikitin, cut at an angle of 25° to the optic axis, gives only a small range of measurement of 550 $\mu\mu$ in Na light. It is shown that it is possible to construct a rotatory compensator of larger range of measurement and of high accuracy from two quartz plates of equal thickness, cut parallel to the optic axis, and placed one above the other in the "subtraction" position. An instrument of this type is described and discussed from the theoretical standpoint. The calculations are checked experimentally. C. J. B. C.

See also Abstracts 1661, 1662.

REFLECTION, REFRACTION AND DISPERSION.

1628. Variation of Reflecting Power with Temperature. L. S. Ornstein and O. Koefoed. *Physica,* 5. *pp.* 175–176, *March*, 1938. *In English.*—Measurements are made of the total reflecting power in the neighbourhood of the Curie-point for Ni (Curie-point 692° K.) and for an Fe-Co alloy containing 22·5% of Co (Curie-point about 1235° K.). The methods employed were the same as those used earlier for Fe [see Abstract 2712 (1936)]. In the case of Ni there is a drop of about 5% in the reflecting power as the Curie-point is passed but no decision is reached as to whether the change is abrupt or not. In the case of the alloy the reflecting power increases continuously with the temperature around the Curie-point. A. H.

1629. Determination of Long Focal Lengths. H. Schulz. *Zeits. f. techn. Physik*, **19**. 2. *pp*. 34–36, 1938.—A method of determining long focal lengths of lenses is described. The method uses two plane mirrors, avoids the use of a long optical bench, and gives more accurate results than combination methods. A. J. M.

1630. Harting's Criterion for Complete Achromatism. F. H. Perrin. *J.O.S.A.* **28**. *pp*. 86–93, *March*, 1938.—If the glasses of an infinitely thin doublet obey Hartmann's three-constant dispersion formula, complete achromatism can be obtained on condition that the λ_0-values of the two glasses be identical. This condition seems to have been first pointed out by Harting, and it is termed Harting's criterion herein. It can rarely be even approximately fulfilled in practice because the ν-values of realisable glasses would not be sufficiently different; this is shown by a plot of many current glasses and some obsolete ones. The relation of Harting's criterion to König's partial-dispersion criterion is discussed with a plot, as also is Lee's suggestion that a plot of c versus n_0 segregates the barium flints. Slevogt's conclusions for the more general case when a is different for the two glasses are considered briefly. Fused silica and some crystals of possible use in optical systems are also discussed; their Hartmann constants for the visible and the u.v. regions are tabulated. Some of these materials have favourable characteristics in the visible region, but all that were studied fail in the u.v. just as do glasses in the visible. AUTHOR.

1631. Refraction of Halogenated Methane Derivatives Containing One or More Nitro Groups. J. M. Stevels. *Faraday Soc., Trans.* **34**. *pp*. 426–428, *March*, 1938.—By comparing the different refraction data given for halogenated methane derivatives containing one or more nitro groups the β_{NO_2} and A_{NO_2} values have been calculated. These values give the "influence" of the nitro groups on the refraction of other substituents and the "sensitivity" of the refractions of the nitro groups for other substituents respectively. β_{NO_2} and A_{NO_2} are compared with the values for the hydrogen and halogen atoms. [See also Abstract 4961 (1937).]. AUTHOR.

***1632. Optical Instruments. J. Guild.** *Journ. Sci. Instruments*, **15**. *pp*. 65–72, *Feb*., 1938.—A review of the instruments shown at the 1938 Exhibition of the Physical Society. W. S. S.

***1633. Kern Self-Computing Telescopic Graphometer. F. Löschner.** *Zeits. f. Instrumentenk.* **58**. *pp*. 49–62, *Feb*., 1938.—A full description is given of the construction and method of use of the instrument. Tests made with the instrument showed a high degree of accuracy. It is stated to be very useful for constructional engineers and for topography. R. S. R.

See also Abstracts 1375, 1490.

SPECTROSCOPY.

1634. Absolute Determination of Luminous Wave-Lengths as a Function of the Metric Unit. A. Pérard. *Comptes Rendus*, **206**. *pp*. 497–499, *Feb*. 14, 1938.—The method described depends on the property of optically plane surfaces of adhering almost perfectly to each other, and consists in graduating a single invar grating 988 mm. long in terms of luminous wave-lengths and in terms of the metre. The former is effected by means of a Michelson interferometer with the help of gratings of intermediate length, and the latter by means of special calibration.

N. M. B.

1635. Calibration Wave-Lengths for Infra-Red Spectrometers. P. E. Shearin and E. K. Plyler. *J.O.S.A.* 28. *pp.* 61–62, *March*, 1938.—About 20 wave-lengths which have been measured on grating spectrometers have been given for the calibration of prism spectrometers in the region from about 2μ to 24μ. A number of lines due to H_2O and CO_2 can be normally observed due to atmospheric absorption. Since not many sharp bands have been measured on grating spectrometers from 7μ to 13μ, several sharp bands in ethyl alcohol and amyl alcohol in the liquid state have been measured in this region. The values found in the present work check well with those previously found by Weniger except those in the 9μ and 10μ region. Here some of the bands differ by about 0·2μ from those found in this work. This difference is probably due to the fact that Weniger did not have the more accurate values of the index of refraction of rock-salt due to Paschen, at his disposal. AUTHORS.

1636. Thorium Spectrum. M. Fred. *Astrophys. J.* 87. *pp.* 176–197, *March*, 1938.—Part of the Th spectrum has been separated into about 750 Th I lines and 2000 Th II lines (of which only the most important are given here), primarily on the basis of relative intensities in different parts of the arc gap. This classification has been confirmed by Zeeman patterns where resolved, by furnace data, etc. Certain of the lines of each spectrum have been designated as low-temperature lines. Most of the wave-lengths are given to seven significant figures. It is believed that these data are sufficient for the term analysis of Th I. For Th II better Zeeman patterns are probably necessary. AUTHOR.

1637. Spectroscopic Studies in the Extreme Ultra-Violet. T. Suga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 740. *pp.* 7–31, *Dec.*, 1937. *In English.*—Using a 1 m. vacuum spectrograph of Siegbahn type, the extreme u.v. spectra of H, He and Ne were investigated. Special attention was paid to the influence of a trace of one gas mixed in another. Extension of the series was achieved for the following series: Lyman series of H (formerly $n = 15$ now to $n = 22$), He I, $1^1S_0 - m^1P_1$; He II, $1^2S_{\frac{1}{2}} - m^2P_{\frac{1}{2},\frac{3}{2}}$; and Ne I, $1^1S_0 - m^1P_1$, $1^1S_0 - m^3P_1$, $1^1S_0 - md_5$, $1^1S_0 - md_2$, $1^1S_0 - ms'_1$. Various methods of excitation were tried, such as d.c. arc with a hollow kathode, or with a water-cooled kathode; a.c. excitation giving disruptive discharge, etc. Among the various features thus presented, the following may be mentioned: (i) The particular enhancement of the intercombination line of He I, 591 Å, $\nu = 1^1S_0 - 2^3P_1$, in a d.c. discharge, (ii) The appearance of many forbidden He I lines violating the ΔL-rule in a disruptive discharge, (iii) Change in the relative intensity of He I and He II spectra, according to the difference in the condition of excitation. Especially interesting was the change in the relative intensities of Ne I lines $1^1S^0 - 4^1P_1$, $1^1S_0 - 4^3P_1$, $1^1S_0 - 5^1P_1$ and $1^1S_0 - 5^3P_1$ when a trace of Ne was mixed in He as compared with the case of using pure Ne. AUTHOR.

1638. Near Infra-Red Spectrum of Hg I. T. Suga, M. Kamiyama and T. Sugiura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 741. *pp.* 32–49, *Dec.*, 1937. *In English.*—Using a 30-A Hg arc as the source of light, and with the long exposure extending to 100 hr., the Hg I spectrum in the near infra-red region was investigated. Com-

V.4
193

pared with the results of the authors' previous experiment the accuracy of the measurement was considerably improved (error ± 0·01 Å) by the use of a plane grating and a 1 m. objective lens, instead of the prism spectrograph. Among the 214 lines observed in the region between 6700 Å and 13700 Å, about 50 lines were newly found, of which 24 lines were designated into different series. Although rather narrow in the range, a remarkable high sensitivity of the "Sakura" 950 film in the region near 10000 Å was noticed.

1639. Excitation in Sources for Spectroscopic Analysis. G. O. Langstroth and D. R. McRae. *Canad. J. of Research*, 16. *Sect.A. pp.* 17–27, *Jan.*, 1938.—From the viewpoint of the spectroscopic analyst, it is desirable to obtain some knowledge concerning the phenomena that result in the emission of radiation from certain types of sources. Results of intensity measurements on the vibration bands of the violet cyanogen system, and on certain lines in the tin spectrum, indicate that in the condensed d.c. and a.c. spark discharges the excitation is predominantly thermal in character, just as in the freely burning carbon arc. The values for the maximum temperature in the discharge columns of these three sources were found to be very nearly 9500°, 7800°, and 7000° K., respectively. It was observed, however, that the Boltzmann character of the distribution over various energy states was lost when the usual inductance was removed from the d.c. spark circuit. One of the five investigated tin levels exhibited an abnormal behaviour, which may possibly be accounted for by the occurrence of collisions of the second kind. There is also evidence to show that the emitting column is surrounded by a relatively cold layer of atoms originating in the material placed on the electrode. This layer absorbs some of the intensity of the lines ending on the ground level. AUTHORS.

1640. Relative Transition-Probabilities in Cd Spectrum. L. S. Ornstein, J. P. A. van Hengstum and H. Brinkman. *Physica*, 5. *pp.* 145–152, *March*, 1938. *In English.*—In d.c. and a.c. carbon arcs in air between Cd-filled electrodes, the relative intensities of the main Cd-lines have been measured photographically. Assuming that these arcs are Boltzmann-radiators after the theory of Ornstein and Brinkman, the relative transition-probabilities of the Cd-lines are derived from the intensities and the spectroscopically measured temperature of the gas in the column of the arcs. The excellent agreement between the transition probabilities obtained with d.c. arcs of different temperatures and in different phases of a.c. arcs, again with different temperatures, shows the existence of the assumed thermic excitation mechanism in the column of these arcs. The measured relative values of the Einstein transition probabilities for Cd are shown in a table and a diagram. The sum rule for intensities has been checked for some multiplets. In the $m\,^3S$–$5\,^3P$ triplets small deviations seem to exist; within the $m\,^3D$–$5\,^3P$ multiplets the agreement with the theoretically predicted intensities is good. AUTHORS.

1641. Hyperfine Structure of the Forbidden Hg-Line 2655·8 Å (6^3P_0–6^1S_0). S. Mrozowski. *Zeits. f. Physik*, 108. 3–4. *pp.* 204–211, 1938.—The hyperfine structure of the line Hg 2655·8 Å, which is observed on optical excitation of Hg vapour and on addition of N_2, is studied under high resolving power. It consists of two components, emitted by the two odd isotopes of Hg. The forbidden transition is caused by the coupling of the magnetic moment of the nucleus with the emitting electron. C. B. A.

1642. Fine Structure of the First Spark Spectrum of Arsenic in the Visible Region. S. K. Mukerji. *Indian Journ. Phys.* 11. *pp.* 377–392, *Jan.*, 1938.—The hyperfine structures in the majority of the stronger lines of the first spark spectrum of As in the visible region have been measured and analysed. The source used was a hallow-kathode discharge tube containing arsenic in which He was continuously made to circulate at a low pressure. The structures have been measured by means of a quartz Lummer plate in conjunction with a Hilger's glass spectrograph. The analysis has definitely shown that the nuclear spin of As is 3/2. The terms investigated are those belonging to $4s^2.4p\cdot 5s$. and the $4s^2.4p\cdot 5p$. electron configurations found in most of the lines in the visible region. Fine structure interval factors have been calculated for 14 terms belonging to the above electron configurations. In addition, the structures of the terms $sp^{33}D_2$ and $sp^{33}D_3$ have been determined. The structures of the terms $4d\cdot{}^1D_1$, $4d\cdot{}^3D_1$, and $4f\cdot{}^3F_2$ have also been estimated. The fine structure analysis also confirms the gross structure analysis. AUTHOR.

1643. Intensity Measurements in Hyperfine Structure of the Mercury Line 6^3P_2-7^3S_1, 5461 Å in Absorption. H. C. Burger and P. H. van Cittert. *Physica,* 5. *pp.* 177–187, *March,* 1938. *In English.*—The wave-number differences and the intensities of the hyperfine structure components of the green Hg line (5461 Å) are measured in absorption. They are found in good accordance with Schüler's theory, if the interpretation of the structure of the central components is slightly altered. The centres of gravity of the isotope lines 199 and 201 coincide with the lines 198 and 200 respectively. AUTHORS.

1644. Nuclear Moments of Indium. S. Millman, I. I. Rabi and J. R. Zacharias. *Phys. Rev.* 53. *pp.* 384–391, *March* 1, 1938.—The atomic beam method of zero moments has been applied to measure the nuclear spin, the h.f.s. $\Delta\nu$ of the normal ${}^2P_{1/2}$ state and the absolute magnetic moment of In 115. The spin was found to be 9/2 and the $\Delta\nu = 0\cdot381$ cm^{-1}. in agreement with spectroscopic results. The resolving power which was attained was sufficiently high to allow a measurement of the fine structure of the zero moment peaks. From the separation of the two $m = -3$ peaks and the diamagnetic susceptibility, the moment of indium 115 is calculated to be $6\cdot40 \pm 0\cdot20$ nuclear magnetons. From the theory of this effect which is given below, it is clear that this value does not depend on any assumption with regard to the interaction between the nuclear spin and the electron configuration. Peaks arising from the metastable ${}^2P_{3/2}$ state, lying $2212\cdot6$ cm^{-1}. above the ${}^2P_{1/2}$ state were found. The intensity of these peaks is in good agreement with quantum statistics. Their exact location will permit an evaluation of the nuclear quadrupole moment. AUTHORS.

1645. Spectrum of Argon A$^+$. W. v. Meyeren. *Ann. d. Physik,* 31. 3. *pp.* 193–218, *Feb.,* 1938.—From description of the spectrum it is found that the coupling relation of the terms is uniquely fixed by the multiplet separation. The intensity-ratio in a line-multiplet is abnormal at high pressures but can be calculated at low where the self-absorption does not falsify results. The intensity distribution for the $({}^1D) + 4p$ and $({}^1D) + 4d$ electron-configurations is investigated. F. S.

1646. Spectra of the Cæsium Molecule. W. Finkelnburg and O. T. Hahn. *Phys. Zeits.* 39. *pp.* 98–100, *Jan.* 15, 1938.—An Osram tube with oxide electrode and filled with A was used as source. For absorption measurements this tube was placed in an electric oven and a tungsten lamp used as source. Photographs were taken with a 3 m. grating spectrograph. Wave-lengths of 118 band heads between 11292 Å and 9077 Å are given correct to ± 0·2 Å, and it is concluded that Loomis and Kusch's arrangement is incorrect. In emission, diffuse bands are also found at 7187, 7127 and 7060 Å. Moment of inertia, rotation constant, etc., are calculated and the values compared with those for Rb. F. S.

1647. Influence of Solvents on the Infra-Red Absorption of Solutions of Neodymium and Samarium Acetyl Acetonates. M. Radoitchitch. *Comptes Rendus*, 206. *pp*. 335–337, *Jan*. 31, 1938.—The absorption of various salts of the rare earths in organic and aqueous solution have been examined. The bands suffer changes of intensity and position dependent upon the solvent. H. G. C.

1648. Infra-Red Absorption Spectrum of Methylene Chloride. C. Corin and G. B. B. M. Sutherland. *Roy. Soc., Proc.* 165*A*. *pp*. 43–53, *March* 18, 1938.—The infra-red absorption spectrum of methylene chloride has been investigated in the liquid state between 2 and 12μ with a prism spectrometer. Twenty-six bands have been observed of which sixteen have not been recorded before; the positions and intensities of the remaining ten agree well with the works of other observers. The most important fact which emerges is that one of the very intense absorption bands has no counterpart in the Raman spectrum of this molecule. This has necessitated a new assignment of the fundamental frequencies, which has been done partly by the method of independent groups and partly by applying the theory of the isotope effect in a molecule of the type YX_4. The latter is a new and surprisingly successful method of forming a rough numerical estimate of the magnitude of certain of the frequencies of the YX_2Z_2 molecule from a knowledge of the potential constants of the YX_4 and YZ_4 molecules. The twenty-six observed bands are accounted for very simply in terms of the new set of fundamental frequencies. AUTHORS.

1649. Dissociation Energy of the CN Molecule. R. Schmid, L. Gerö and J. Zemplén. *Phys. Soc., Proc.* 50. *pp*. 283–292, *March* 1, 1938.—The perturbations observed on the vibrational levels of the B $^2\Sigma$ state of CN must be caused by intersections with levels of a $^2\Pi$ state as established by the widening of the spin doublets of the B $^2\Sigma$ state, *i.e.*, by the simultaneous but unequal shifting of the spin-doublet components and by the decay of the perturbations with decreasing rotational quantum numbers, leaving the rotationless states unaffected. The perturbing state must be identical with the known A $^2\Pi$ state of CN, as proved by the observed positions of the perturbed places in the CN level scheme. In this way the vibrational set of the A $^2\Pi$ state becomes observable up to the 30th sublevel, where the vibrational convergence is already very marked. A short extrapolation fixes the convergence limit at about 60500 ± 1000 cm^{-1}. above the ground state X $^2\Sigma$ ($v = 0$, $J = 0$) of CN. A comparison of the positions of vibrational levels of the X $^2\Sigma$ and A $^2\Pi$ states shows that the convergence limit of the former should lie in the neighbourhood of the latter; the B $^2\Sigma$ state converges to about 65500 ± 1000 cm^{-1}. On this basis the correlation between C + N and CN levels is found as follows: A $^2\Pi_{\text{convergence}} \rightarrow \text{C}\ (^3\text{P}) + \text{N}\ (^2\text{P}) = 60500 \pm 1000$ cm^{-1}. and B $^2\Sigma_{\text{convergence}} \rightarrow \text{C}\ (^5\text{S}) + \text{N}\ (^4\text{S}) = 65500 \pm 1000$ cm^{-1}. This could then be verified by the observation of intensity drops at energy values where the other C + N term combinations fall. Thus for the dissociation energy of the CN molecule into tetravalent C (^{5}S) and trivalent N (^{4}S) atoms 8·09 eV is obtained, in very good agreement with calculations made on the basis of CO $(x\,^1\Sigma)$ + 11·06 eV → C (^{5}S) + O (^{3}P). AUTHORS.

1650. Electronic Transitions and Absorption Spectra of Pr^{+++} Ions. P. C. Mukherji. *Indian Journ. Phys.* 11. *pp.* 399–407, *Jan.,* 1938.—The absorption spectra of Pr^{+++} ions in solution and in crystals have been investigated here over the region from 900 mμ to 200 mμ. In solution the intensity of absorption has been measured over the visible region with a double monochromator. Using large single crystals of $PrCl_3,7H_2O$, the changes brought about at liquid-air temperature in the nature of the different groups of absorption lines and bands have been studied. A preliminary classification of these groups of absorption lines and bands is given based on the assumption that they are due to inner forbidden transitions. Every transition is supposed to give rise to a group. In this process of classification the term values of Pr IV have been calculated from those of La II and compared with the mean frequencies of the different groups obtained in absorption. The van Vleck's theory of the absorption spectra of rare earths in solids has been discussed. A scheme of classification of the rare-earth spectra presented by Ellis has been noted and the divergences explained. [See also Abstract 4045 (1937).] AUTHOR.

1651. Influence of Salts on the Absorption Spectra of Aqueous Cobalt Chloride Solutions. J. N. Pearce and L. R. Dawson. *J. Chem. Phys.* 6. *pp.* 128–130, *March,* 1938.—The effects of equal concentrations of the alkali and alkaline earth chlorides and of HCl on the absorption spectra of aqueous cobalt chloride solutions have been studied. Solutions prepared both on the molar and on the molal bases were used. In all cases, the absorption bands widen with an increase in concentration of the added salt. The increase in width of the absorption bands varies directly as the ionic charge and inversely as the ionic volume of the added kation. The inadequacy of existing explanations of the well-known colour changes in cobalt chloride solutions is discussed and a new explanation is offered. AUTHORS.

***1652. Spectrum of Manganese Hydride, MnH. R. W. B. Pearse and A. G. Gaydon.** *Phys. Soc., Proc.* 50. *pp.* 201–206, *March* 1, 1938.—A discharge tube suitable for the excitation of band spectra of the hydrides of refractory metals which do not appear well in a vacuum arc, is described. The spectrum of MnH is described ; bands have been observed in the red, yellow-green, green, blue, and blue-violet regions of the spectrum. Vibrational quantum numbers are assigned to the bands. The spectrum of MnH is briefly discussed in relation to the spectra of CaH, CrH, FeH, CoH, NiH, CuH, and ZnH. AUTHORS.

1653. Rotational Energy Distribution of OH Molecules from the λ3064 Band. E. R. Lyman. *Phys. Rev.* 53. *pp.* 379–383, *March* 1, 1938.—The rotational energy distribution of the OH molecules has been studied by photometric measurement of the λ3064 band. The band excited in the oxy-hydrogen flame and in the Cu arc shows a thermal distribution of intensities from which temperatures of 3275° K. and 6350° K. respectively, are calculated. The spectrum excited in vacuum tube discharges shows abnormal rotational energy which varies with the pressure of the water vapour in the tube. At current densities used in the experiment, no reduction of rotational energy could be obtained by addition of excess foreign gas. AUTHOR.

1654. Vibration-Rotation Energy of Polyatomic Molecules. M. Eliashevich. *Acta Physicochimica,* 8. 1. *pp.* 9–26, 1938. *In English.*

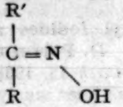
—In an attempt to develop a consistent general theory of the vibration-rotation energy of polyatomic molecules some general considerations are discussed regarding the correct division of the total energy into parts. From the point of view of the use of the theory in practice an examination is made of the coordinates which must be used, and of the use and order of magnitude of different terms in the Hamiltonian. A. H.

1655. Continuous Absorption Spectra of Alkyl Iodides and Alkyl Bromides and their Quantal Interpretation. D. Porret and C. F. Goodeve. *Roy. Soc., Proc.* 165*A. pp.* 31–42, *March* 18, 1938.—The extinction coefficient curve for methyl iodide has been analysed according to the method used by Fink and Goodeve, and the existence of two bands has been deduced. The upper potential energy curves corresponding to these bands have been determined. The extinction coefficients of ethyl iodide and of ethyl and butyl bromides have been determined over a wide range. Influence of the carbon chain is found to be small. The conditions under which chromophoric groupings retain their individuality are discussed. AUTHORS.

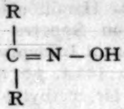
1656. Zeeman Effect in Intense Magnetic Fields. P. Jacquinot. *Ann. de Physique*, 9. *pp.* 236–317, *Feb.*, 1938.—The Bellevue electromagnet and the second and third orders of 6 m. Rowland grating were employed. The source was a tube excited by a h.f. discharge (10 m.) between external electrodes, the electric field being parallel to the magnetic. The components of the triplet formed in intense fields are complex for the Li λ6708 doublet with a field of 44000 G. Houston's theory is extended to take account of the Paschen-Back Effect for all couplings. One method of calculation gives the effect with all fields, a second method takes account of only two of the terms, giving the effect of field strength and is particularly applicable to j-j coupling. In an experimental study of the 6*s*6*d* and 6*s*7*d* configuration of Hg many anomalies are found. It is possible to account for all the observations by selecting a suitable value of X (the parameter of electrostatic interaction) but no single value of X accounts for all the phenomena. As regards p^5ns levels of Ne 12 faint lines representing a case of j-j coupling verified the theory. H. G. C.

1657. Raman Spectra of Hydrochlorides of Various Compounds. H. J. Bernstein and W. H. Martin. *Roy. Soc. Canada, Trans.* 31. *Sect. III. pp.* 95–103, *May*, 1937.—The Raman spectra of mercuric chloride, methylamine, hydroxylamine and pyridine and their hydrochlorides have been obtained. The complex $HgCl_2 \cdot 2HCl$ is shown to exist in solutions of $HgCl_2$ and HCl. In all cases the spectra of the hydrochlorides in solution are due to their respective ions, viz.: $HgCl_4^{--}$, $CH_3NH_3^+$, NH_3OH^+, $C_5H_6N^+$. The results obtained indicate that in the ion the atom or atoms which are bound to the parent molecule, giving it the ionic charge, are not covalently linked but are held in the ion by forces which do not give rise to their own Raman lines but which modify the spectrum of the original molecule. AUTHORS.

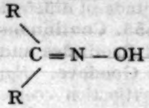
1658. Raman Spectra of Oximes. H. J. Bernstein and W. H. Martin. *Roy. Soc. Canada, Trans.* 31. *Sect. III. pp.* 105–113, *May*, 1937.—The Raman spectra of dimethyl ketoxime, diethyl ketoxime, and acetaldoxime have been obtained. All of the spectra show a band corresponding to the O-H vibration. The formula of the unsymmetrical ketoximes therefore can be written as (1); for the symmetrical ketoximes an analysis of the modes of vibration for the model (2) shows that this formula accounts satisfactorily for the principal Raman lines of such compounds. Since, however, the value of the deformation force constant (K_2) used in the calculation was obtained for a linear C-C-C group the conclusion that the R-C-R group is linear is scarcely justified. The formula for the symmetrical ketoximes is therefore better left in the more general form (3).

(1) 

$\underset{\mathrm{R}}{\overset{\mathrm{R'}}{\mathrm{C}}}=\underset{\diagdown\mathrm{OH}}{\mathrm{N}}$

(2) 

$\underset{\mathrm{R}}{\overset{\mathrm{R}}{\mathrm{C}}}=\mathrm{N}-\mathrm{OH}$

(3) 

$\underset{\mathrm{R}\diagup}{\overset{\mathrm{R}\diagdown}{\mathrm{C}}}=\mathrm{N}-\mathrm{OH}$

AUTHORS.

1659. Hydroxyl Frequency in the Raman Spectra of Acids and Acid Salts. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 13–20, *Jan.*, 1938.—The Raman spectra of H_2SO_4, HIO_3, H_2SeO_3, H_6TeO_6, NaH_2PO_4 and $KHSO_4$ have been obtained under long exposure and using complementary filters. In every case, a band characteristic of the O-H group has been recorded. The band is weak and diffuse, and is shifted to a frequency considerably lower than that due to free O-H group. The results are discussed in relation to electrolytic dissociation and molecular structure of these compounds. From the nature of the spectra, the characteristic features of the Raman band due to the so-called H bond are deduced. Some new Raman frequencies in H_2SeO_3 and H_6TeO_6 are indicated in the paper. AUTHOR.

1660. Raman Spectra of Mixed Crystals. S. C. Sirkar and I. Bishui. *Indian Journ. Phys.* 11. *pp.* 417–425, *Jan.*, 1938.—The Raman spectra of mixed crystals of *p*-dichlorobenzene and *p*-dibromobenzene have been re-investigated. It is pointed out that the observed facts, which are at variance with some of those observed by Vuks, do not definitely lead to the conclusion that the new intense Raman lines having values of $\Delta\nu$ less than 100 cm^{-1}. observed in these cases are due to lattice oscillations. It is pointed out that besides these investigations of the Raman spectra, investigations of other properties of the crystals have to be made before coming to the conclusion mentioned above. AUTHORS.

1661. Raman Effect in Gases Under Normal Pressure. J. Cabannes and A. Rousset. *Comptes Rendus*, 206. *pp.* 85–88, *Jan.* 10, 1938.—With an improved spectrograph, with an objective F/0·7, the authors have photographed Raman spectra of gases at normal pressure with comparatively short exposure times. The determination of depolarisation ratios took many hours. Depolarisation ratios and the frequencies of the lines are given for one strong line for each of the gases N_2, O_2, H_2, CO, NO, CO_2, and NH_3, and two for NO_2. The primary object was to see if the depolarisation calculated from Silberstein's hypothesis of the origin of molecular anisotropy were correct. They find the calculated values to be several times too large. It is interesting that the gases CO and NO on the one hand, and CO_2 and NO_2 on the other, have depolarisations which are almost equal. The most unexpected result occurred when ammonia was investigated. With a pyramidal NH_3 model, one would expect only two lines in the region 3300 m^{-1}., one polarised and the other depolarised. The authors find 3335 and 3520 which have these polarisatious respectively, but in addition the weak line 3219 which has a counterpart at 3210 in liquid NH_3 and 3237 in solid NH_3. **Erratum,** *ibid. p.* 220, *Jan.* 17, 1938. A. C. M.

1662. Simple Method for Determining the Polarisation of Raman Lines. J. T. Edsall and E. B. Wilson, Jr. *J. Chem. Phys.* 6. *pp.* 124–127, *March*, 1938.—A simple method is described for determining qualitatively the polarisation of Raman lines. The incident light is polarised by means of " Polaroid." One of the arrangements used permits very high intensity of incident illumination. A brief statement of the theory of the method is given, and experimental data on acetic acid, acetone and ethanol are presented. AUTHORS.

1663. Isotope Effect in Vibration Spectrum of CCl_4. C. K. Wu and G. B. B. M. Sutherland. *J. Chem. Phys.* 6. *pp.* 114–118, *March*, 1938.—The fine structure in certain of the Raman lines of CCl_4 observed by Langseth and interpreted by him as being due to a lack of symmetry in the four C valencies has been shown to be accountable for as a purely isotopic effect. Rosenthal's general theory of the isotope effect in molecules of this type have been applied to the case of CCl_4 in an attempt to differentiate between two types of potential function which have been proposed for this molecule. The fine structure patterns predicted on the different theories have been worked out. Unfortunately the existing experimental data are not sufficiently good to allow a decision to be made as to which is the better function. AUTHORS.

***1664. Grating Monochromator for the Schumann Region. R. F. Baker.** *J.O.S.A.* 28. *pp.* 55–60, *March*, 1938.—A vacuum grating monochromator is described, suitable for photoelectric research in the Schumann region. A H_2-discharge tube serves as a light source, and radiation intensities are measured with a K photo-cell and fluorescent filter. Photo-currents are measured with a Compton electrometer, by the steady deflection method. The photoelectric yield of Cd is measured from the threshold of 1000 Å, and curves are given showing a maximum for the surface effect and the onset of the volume effect. AUTHOR.

***1665. Short-Wave Ultra-Violet Photoelectric Spectrophotometer of High Accuracy. W. Deck.** *Helv. Phys. Acta*, 11. 1. *pp.* 3–58, 1938. *In German.*—The object was to construct a u.v. spectrophotometer giving the greatest attainable accuracy. Critical studies were made of the different factors : types of light source, photographic or photoelectric detection, deflection or null method, type of photo-cell or photon counter, fluctuations of the light source or cell currents, etc. The instrument finally developed employed a double monochromator, the beam from which was split into a main beam which passed through the specimen under measurement and then fell on a gas-filled Na quartz photo-cell, and a comparison beam which after reflection fell on another similar cell. D.c. amplification of the current from each cell was accomplished with an electrometer valve, the two valves being connected in a bridge circuit. The bridge was balanced by the adjustment of a variable rotating sector in the main beam. An important feature was the placing of cells and amplifier valves in an evacuated enclosure. The measurement of extinction coefficients with this apparatus could be made with a reproducibility of from 0·1% in unfavourable, to 0·01% in the best conditions. By the use of a high consumption hydrogen lamp it was possible to work down to about 2000 Å. W. S. S.

See also Abstracts 1372, 1540, 1554, 1580, 1590, 1591, 1607, 1666, 1703, 1704, 1708.

TRANSMISSION.

1666. Far Infra-Red Transmission of Benzene Derivatives. M. Parodi. *Comptes Rendus,* 206. *pp.* 337–339, *Jan.* 31, 1938.—The powdered material placed between two pieces of paraffin was examined by means of residual rays. A band at 27 μ is attributed to NH_2 or OH. The band at $37\cdot7\ \mu$ in hexachlorobenzene decreases in wave-length regularly with decreasing numbers of halogen atoms. The loss of symmetry consequent on the reduction of the number of halogen atoms under 6 results in increased complexity of the spectra. H. G. C.

See also Abstracts 1494, 1619.

X-RAYS.

1667. Production of X-Rays by High Speed Argon Ions. M. Tanaka and I. Nonaka. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 33–51, *Jan.,* 1938. *In English.*—Argon ions of energies up to 450 eKV were obtained by the multiple linear accelerator method of Sloan-Lawrence, and X-rays produced when each one of the elements Li, Be, C, Mg, Al, Si, Ni, Cu, Zn, Mo, Pd, Ag, Cd, Sn, Pt, Au, and Pb was bombarded by these ions were investigated by Geiger counter. From the measurements of the absorption of the X-rays, by thin starch films, these radiations were determined to be the characteristic K in the cases of Mg, Al and Si; the characteristic L in the cases of Mo, Pd, Ag, Cd and Sn; and the characteristic M in the cases of Pt, Au and Pb. The relative number of photons of these characteristic radiations when thick targets were bombarded by ions of 440 ekV were obtained. According to that result, the intensities of the characteristic L radiations were far stronger than those of K and M, which is contrary to the cases of protons and α-particles, but agrees with the case of Hg ions. The intensity of each characteristic radiation was found to increase very rapidly with the energy of the ions, and also found to be proportional to $W^{3.7}$ in the case of Ag L radiation, where W is the energy of ions. AUTHORS.

1668. Theory of X-Ray Absorption and Heat of Sublimation of Zinc. M. Satô. *Tohoku Univ., Sci. Reports,* 26. *pp.* 341–382, *Dec.,* 1937. *In English. Reports Nos.* 433 *and* 434 *of the Research Inst. for Iron, Steel and other Metals.*—In previous work the author has shown that the K-absorption of X-rays by Zn can be split into two processes [see Abstract 5170 (1937)]. The main stage is shown to be the electron transition from the *k*-shell $(1s)^{21}\ S_0$ to the optical level $(4s,\ 4s)^1\ P_1$ Zn 1, giving the so-called K-absorption edge; the auxiliary stage gives rise to broadening of the K-absorption edge, to the emission lines $K\beta_2$ and $K\beta'''$, and to a fine structure of the main edge itself. For $L_{II,\ III}$-absorption, the main process is electron transition to the optical level of the triplet system of Zn 1 $(4s,\ 6p)^3\ S_1$; the auxiliary process is electron transition between the levels of the Zn 1 system. For ZnO similar absorption phenomena are investigated, they comprise the above processes together with auxiliary ones consisting of electron transitions between atomic levels of the O of ZnO, this causes shifting of the absorption edges. From the elevation and depression of the crystal levels normal for the isolated Zn atom the heat of sublimation of solid Zn is found to be $0\cdot099$ Rydberg units by theoretical calculation, in excellent agreement with experimental (I.C.T.) values corrected for recent determinations of the vapour pressure of solid Zn [see Abstract 1751 (1935)]. D. R. H.

1669. X-Ray Spectroscopic Data in Regard to the Electronic Energy Bands in KCl and NaCl. J. Valasek. *Phys. Rev.* 53. *pp.* 274–277, *Feb.* 15, 1938.—The wave-lengths of several lines in the $K\beta$ group of Cl in NaCl and KCl, and of K in KCl, have been measured in the secondary radiation from pressed blocks of the salts. The results are discussed in terms of the electronic energy bands in these crystals. It is shown that certain of the weaker lines arise from transitions of valence electrons belonging to one of the ions into a K-shell vacancy in the other ion. Some of the residual non-diagram lines seem to be related to the excited levels in irradiated crystals. AUTHOR.

***1670. X-Ray Micro-Analyser. L. v. Hámos.** *Journ. Sci. Instruments*, 15. *pp.* 87–94, *March*, 1938.—An X-ray micro-analyser is described; it produces true monochromatic X-ray images of the surface of a sample exposed to primary X-rays. The characteristic X-rays emanating from the sample are reflected by a concave crystal mirror to form photographs of the surface. Each of the X-ray photographs represents the distribution of a definite chemical element over the surface of the sample. Some of the optical properties of such an arrangement are discussed. It is shown that chemical micro-analysis is made possible by means of X-rays without dissipation of the sample. The application of this method to problems in mineralogy and metallography is illustrated by typical X-ray micro-photographs. AUTHOR.

HEAT.

CALORIMETRY.

1671. Atomic Heats of Supraconducting and Non-Supraconducting Tin. W. H. Keesom and P. H. van Laer. *K. Onnes Lab. Leiden, Comm. No.* 252*b*. *Physica*, 5. *pp.* 193–201, *March*, 1938. *In English.*—A report is given of measurements on the atomic heats of tin in the supraconductive state and while placed in a magnetic field so as to destroy supraconductivity. In the supraconductive state the atomic heat appears to follow a T^3-law. For the atomic heat in the normal state it was possible to find values of Θ_D and γ so as to satisfy the equation $C_n = 464\cdot5\,(T/\Theta)^3 + \gamma T$. The linear term may be ascribed to the electronic heat capacity according to Sommerfeld. The value of $\gamma = 0\cdot00040$, corresponding to 7·2 "free electrons per atom." The difference $C_s - C_n$ and $S_s - S_n$ arising from these measurements appear to agree very well with those obtained from the threshold value curve. The specific heat in the normal state does not show any dependence on the magnetic field. AUTHORS.

***1672. Automatic Calorimeter for Continued Measurement of Heat Production. W. M. Barrows, Jr. and J. R. Murlin.** *Am. Phil. Soc., Proc.* 78. 3. *pp.* 483–512, 1938.—An automatic respiration calorimeter is described capable of measuring both directly and indirectly at the same time, the heat production of groups of 12–30 rats or of a dog weighing 10–20 kg. over long periods of time. The apparatus operates on the principle of successive differential calorimetry. Descriptions are given of the controlling and recording mechanisms, of both a closed-circuit and an open-circuit method of chamber ventilation and also of a new method of thermostatically controlling the room in which the apparatus stands. R. L.

See also Abstracts 1380, 1668, 1677, 1678, 1679.

CONDUCTION.

1673. Theory of Heat Conduction. W. Kroll. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 756. *pp.* 194–196, *Feb.*, 1938. *In German.*—Wilson's expression for the dependence of thermal conductivity, (λ), upon temperature indicates that λ increases from zero value at absolute zero to a maximum value and thereafter approximates to the Wiedemann-Franz value at high temperatures [see Abstract 3707 (1937)]. In continuation of previous work [see Abstract 2471 (1933)], the author suggests that the maximum value of λ is not derived from the theory itself but arises owing to the degree of approximation made in developing certain expressions associated with the stationary condition. J. S. G. T.

See also Abstract 1373.

DILATATION.

See Abstract 1380.

TEMPERATURE.

***1674. Photo-Thermometry. P. Neubert.** *Arch. f. Wärmewirtsch.* 19. *pp.* 29–32, *Feb.*, 1938.—A further account of the method developed by the author [see Abstract 5201 (1936)] for the measurement of temperatures down to about 250° C. by means of infra-red photographs. Curves are given showing how the degree of blackening of the plate varies with the temperature of the object, and also the correction to be applied to the observed temperature to allow for departure from black body surface conditions. Several examples are included illustrating applications of the method, both the actual photographs and the curves derived from these for the temperature distributions being reproduced. R. W. P.

***1675. Mechanical and Thermal Instruments. G. A. Tomlinson.** *Journ. Sci. Instruments*, 15. *pp.* 61–65, *Feb.*, 1938.—A review of the instruments shown at the 1938 Exhibition of the Physical Society. W. S. S.

THERMOCHEMISTRY.

1676. Heats of Combustion and Inner Molecular Arrangement. H. Dunken and K. L. Wolf. *Zeits. f. phys. Chem.* 38. *Abt.B.* 6. *pp.* 441–450, 1938.—The energy contents of the free (gaseous) molecules have been calculated from measurements of the heats of combustion and of sublimation of the isomeric tartaric acids, tartaric acid esters and etherified tartaric acid esters and conclusions are derived with respect to the inner molecular arrangements in molecules of this type. The problems of rotation isomerism and polymorphism have been dealt with in particular. [See also Abstract 3330 (1937).] H. H. Ho.

1677. Heat of Formation and Specific Heat of Aluminium Carbide. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 742. *pp.* 50–59, *Dec.*, 1937. *In English.*—The mean specific heat of aluminium carbide was measured by the ice calorimeter over three temperature intervals: 0° C. – 99·6° C., 0° C. – 244° C. and 0° C. – 320·5° C., and the equation of the true specific heat within the limit over the above temperature intervals is obtained: $C = 0{\cdot}2282 + 2{\cdot}12 \times 10^{-4}t - 2{\cdot}842 \times 10^{-8}t^2$. By using this equation, the heat of formation of aluminium carbide was computed from the equilibrium data of the reaction $4AlN + 3C = Al_4C_3 + 2N_2$, taking into consideration the formation of aluminium carbo-nitride Al_5C_3N at high temperatures. The result obtained is as follows: $4Al + 3C = Al_4C_3 + 63200$. AUTHOR.

1678. Heat of Formation and Specific Heat of Silicon Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 751. *pp.* 144–154, *Jan.*, 1938. *In English.*—As the specific heat of silicon nitride has not yet been determined, the mean specific heat was measured by the ice calorimeter over three temperature intervals : 0° C. ∼ 99·5° C., 0° C. ∼ 316·4° C. and 0°C. ∼ 585° C., and the equation of the true specific heat was obtained which holds good over the above temperature ranges : $C = 0{\cdot}1656 + 1{\cdot}847 \times 10^{-4}t - 4{\cdot}5 \times 10^{-8}t^2$. By using this value, the heat of formation of silicon nitride was computed from the dissociation pressure of silicon nitride at high temperatures. The result obtained is as follows : $3Si + 2N_2 = Si_3N_4 + 163000$. The relationship between the heats of formation of nitrides of the elements belonging to the second series of the periodic table and their atomic numbers is discussed. AUTHOR.

1679. Heat of Formation and Specific Heat of Vanadium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 759. *pp.* 241–249, *Feb.*, 1938. *In English.*—The mean specific heat of vanadium nitride was measured by the ice calorimeter over three temperature intervals : 0° C. ∼ 99.6° C., 0° C. ∼ 305·3° C. and 0° C. ∼ 458·6° C. and the equation of the true specific heat within the limit of the above temperature intervals was obtained : $C = 0{\cdot}1351 + 2{\cdot}064 \times 10^{-4}t - 1{\cdot}057 \times 10^{-7}t^2$. By using this value, the heat of formation was computed from the dissociation pressure at high temperatures. The result obtained is as follows : $V + 1/2\,N_2 = VN + 66000$. The relationship between the heats of formation of nitrides of the elements belonging to the third, fourth and fifth groups as well as the third series of the periodic table and their atomic numbers is discussed. AUTHOR.

1680. Spontaneous Ignition under Pressure of Typical Knocking and Non-Knocking Fuels. M. Maccormac and D. T. A. Townend. *Chem. Soc., J. pp.* 238–246, *Feb.*, 1938.—Previous investigations, which had established a close relationship between ease of spontaneous ignition under pressure and the known knocking propensities in engine practice of the simpler paraffins and olefins, have been extended, and the present paper includes observations with some of the newer "high-duty" (non-knocking) fuels, notably *iso*octane, di*iso*propyl ether, and acetone. Much higher pressures are requisite for the spontaneous ignition of side-chain paraffins than for the straight-chain isomers, the temperature ranges in which cool flames are observed and the character of the low-temperature ignition systems induced thereby being much the same in both cases. The cool-flame zones and the lower-ignition systems of the ethers appear to be composite, and much higher pressures are requisite for the ignition of mixtures of air with di*iso*propyl ether than for those with diethyl ether. Acetone has been shown to give rise to cool flames and a simple low-temperature system if the observations are extended to sufficiently high pressures ; and benzene behaves rather like methane, there being no indication at all of a low-temperature system. A scheme is suggested whereby the relative knock-rating of a fuel may be assessed from the characteristics of its spontaneous ignition under pressure. The processes giving rise to the low-temperature ignition systems induced by cool flames are briefly discussed. [See also Abstract 2709 (1937).] AUTHORS.

See also Abstracts 1394, 1649.

THERMODYNAMICS.

1681. Validity of Nernst Heat Law at Absolute Zero. H. Schmolke. *Zeits. f. Physik,* 108. 3–4. *pp.* 183–188, 1938.—It is shown that Planck's form of the Nernst heat law, lim S = 0 for T = 0, where S is entropy and T the absolute temperature implies the disappearance of the specific heat, *c*, at T = 0. Should this form and the consequent conclusion with regard to *c* prove correct, the absolute zero can never be reached. Alternatively, should absolute zero be reached, the Planck form would no longer be valid. On the other hand, the original form of the law, lim Δ S = 0 at T = 0 only requires the heat capacity to remain constant at absolute zero and does not make this temperature unattainable. Only by coupling with the Nernst form the supposition that *c* vanishes at T = 0 does the principle of unattainability result. R. W. P.

1682. Accurate Determination of the Gas-Content of Steel Bottles. J. Otto. *Phys. Zeits.* 39. *pp.* 137–141, *Feb.* 15, 1938. *From the Reichsanstalt.*—Since some constituents are condensible, the calculation of the volume of town gas (H_2 49%, CH_4 19%, C_nH_{2n} 2 %, CO 13%, CO_2 3%, N_2 14%) used [in Germany] as a fuel in motor lorries, by application of Boyle's law after compression, is inaccurate. Experimental determination of compressibility up to 200 kg./mm². (127 tons/in².) at − 50°, zero and 50° C. shows that the calculation of *k* by summation of the *k*'s of the components, also gives wrong results. The errors of the two methods are about equal. The following formula is proposed, where v_0 is the actual volume of the bottle, $\frac{v_n}{v_0} = \frac{p}{p_n} \cdot \frac{1}{k}\left(\frac{273{\cdot}2}{273{\cdot}2+\theta}\right) \cdot \frac{753{\cdot}557}{760}$. D. R. H.

1683. Critical Phenomena in Gases. Part II. J. E. Lennard-Jones and A. F. Devonshire. *Roy. Soc., Proc.* 165*A*. *pp.* 1–11, *March* 18, 1938.—This paper extends to liquids the theory which was given recently [see Abstract 5393 (1937)] by the authors for the equation of state of a gas at high densities. A direct calculation is made of boiling points in terms of interatomic forces and the numerical results for the inert gases are in satisfactory agreement with the observed values. A theoretical interpretation is given of Trouton's empirical rule connecting the heat of vaporisation with the boiling temperature and also of Hildebrand's modified form of it. Calculations are made of the vapour pressures and heats of vaporisation of the inert gases. AUTHORS.

1684. Joule-Thomson Effect in Mixtures of He and N_2. J. R. Roebuck and H. Osterberg. *Am. Chem. Soc., J.* 60. *pp.* 341–351, *Feb.*, 1938.—This article presents : (*a*) data and curves for the variation of the Joule-Thomson coefficient, μ, as a function of pressure (1–200 atm.), of temperature (− 100 to 250° C.) and of composition, for four mixtures of He and N_2. These are obtained from : (*b*) experimental data and curves for the isenthalps of these mixtures ; (*c*) data for the inversion curves ($\mu = 0$) ; (*d*) a general picture of the isenthalpic curves ; (*e*) an application of the theorem of corresponding states to the Joule-Thomson effect. [See also Abstract 4324 (1935).] AUTHORS.

1685. Van der Waals Forces and the Debye-Hückel Theory of Strong Electrolytes. S. Oka. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 11–14, *Jan.*, 1938. *In English.*—Van der Waals forces as well as the ordinary Coulomb forces between ions are considered in the determination of the potential due to the ionic atmosphere. Under certain assumptions it is shown that the van der Waals forces can be neglected in the case of

sufficiently dilute solutions. Thus the thermodynamic limiting laws of strong electrolytes in the theory of Debye and Hückel are justified.
AUTHOR.

1686. Van der Waals Forces in Electrolytes. J. Lange and E. Herre. *Zeits. f. phys. Chem.* 181. *Abt.A.* 5. *pp.* 329–354, 1938.—The van der Waals attraction forces in electrolytes between neighbouring equally and oppositely charged ions are evaluated by means of exact measurements of the freezing point and the conductivity of aqueous solutions of different electrolytes ; the latter contain an ion similar in electronic constitution to an inert gas which is large and strongly polarisable and thereby able to exert considerable van der Waals attraction forces. As a measure of the latter, the degree of association due to the formation of ionic pairs from oppositely charged ions, or to the formation of complex ions from equally charged ions, has been introduced. The degree of association can be given with an accuracy of ± 0·3%, independently of whether the van der Waals attraction forces lead to a regular association in the classical sense or not. Separate experimental results in agreement with optical experience indicate a regular association of equally charged ions to complex ions. For large organic ions such as picrate, methylene blue, etc., the latter association is already so great in 0·01 *N* solutions that it dominates the picture, and for the average inorganic ion is about half as strong as, for example, the formation of neutral molecules in iodic acid. H. H. Ho.

1687. Thermodynamic Properties of Sulphur and its Inorganic Compounds. K. K. Kelley. *Bureau of Mines, Bull. No.* 406. [154 *pp.*], 1937.

1688. Thermodynamic Properties of Metal Carbides and Nitrides. K. K. Kelley. *Bureau of Mines, Bull. No.* 407. [66 *pp.*], 1937.

1689. Thermodynamics of HCl in Dioxane-Water Mixtures from E.M.F. Measurements. Part II. H. S. Harned and C. Calmon. Part III. H. S. Harned. Part IV. H. S. Harned and J. G. Donelson. *Am. Chem. Soc., J.* 60. *pp.* 334–341, *Feb.* 1938. [See also Abstract 1810 (1937).]

See also Abstracts 1438, 1439, 1440, 1441, 1484.

VAPORISATION AND CONDENSATION.

1690. Vapour Pressures of the Polyethylene Glycols and their Derivatives. A. F. Gallaugher and H. Hibbert. *Am. Chem. Soc., J.* 59. *pp.* 2521–2525, *Dec.*, 1937.—Vapour pressure data over a range of about 100° have been determined for mono-, di-, tri-, tetra-ethylene glycols and certain derivatives. Some of these substances show negative deviations from the ratio T_1/T_2 expected from the Ramsay and Young rule. Molecular latent heat and the value of Trouton's constant increase on ascending the glycol series, diethylene glycol itself showing abnormality ; the values obtained with ethylene oxide and dichloride and with 1, 4-dioxane show these liquids to be non-associated. The initial decomposition temperatures of the glycols are a function of the polyethylene oxide chain-length. L. V. C.

1691. Validity of Henry's Law for the Calculation of Vapour Solubilities. J. H. Saylor, J. M. Stuckey and P. M. Gross. *Am. Chem. Soc., J.* 60. *pp.* 373–376, *Feb.*, 1938.—Three different types of experimental tests are employed to test the applicability of Henry's law to aqueous solutions of slightly soluble organic liquids. It is concluded that Henry's law is applicable in concentration ranges below approximately 300 to 400 millimoles per 1000 gm. of water The calculation of vapour solubilities in cases where Henry's law is applicable is discussed. AUTHORS.

See also Abstracts 1480, 1492.

ACOUSTICS.

1692. Violin. P. Jarnak. *Frank. Inst., J.* 225. *pp.* 315–341, *March,* 1938.—An experimental study, with some qualitative theoretical discussion, of certain problems in the acoustics of the violin. The body of the instrument is treated as consisting of six main parts each with its own characteristic modes of vibration. As a result of having a number of coupled resonators, many possible natural frequencies are available for resonance between string and body. Oscillograms of notes played on the new violins made by Jarnak are very similar to those got by using Old Italian violins. There are no details of elaborate control experiments carried out to decide which of a number of factors are essential in a violin giving the tone qualities of some old Italian instruments. W. H. G.

1693. Resonance of Liquids in Tubes. C. Sălceanu and C. Istraty. *Comptes Rendus,* 206. *pp.* 329–330, *Jan.* 31, 1938.—In a previous paper [see Abstract 798 (1938)] a description is given of a resonance method of determining the velocity of sound in liquids in tubes. The present note briefly describes an apparatus consisting of a microphone and a valve amplifier which enables the intensity of sound in the tube to be indicated by the deflection of a galvanometer. Curves showing the variation of intensity of sound along the tube are given for water, ethyl alcohol, acetone and tetrachlormethane, at a number of frequencies. The resonance peaks appear to be extremely sharp. [See following Abstract.] K. M. C.

1694. Acoustic Resonance Spectra of Liquids. C. Sălceanu and C. Istraty. *Comptes Rendus,* 206. *pp.* 502–504, *Feb.* 14, 1938.—Galvanometer deflections are used to measure the intensity of resonance of columns of liquids to notes of different frequencies. Between the principal positions of resonance (*i.e.,* for different thicknesses of liquid) secondary resonance occurs. The occurrence of resonance with thickness forms a spectrum. Graphs show resonance spectra for water, ethyl alcohol and acetone for four frequencies. In the case of the last two liquids, the principal resonance spectra are nearly equal but the secondary spectra differ widely. In all cases only the length of the liquid column is varied. The resonance curves are very sharp in contrast to the flat curves obtained with gases. [See preceding Abstract.] H. M. B.

1695. Dispersion of Supersonic Waves in Liquids. Parts I and II. B. G. Špakovskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 3. *pp.* 169–175, 1938. *In English.*—The velocity of propagation of supersonic waves in pure liquids and in aqueous solutions is determined using an acoustic interferometer described in an earlier paper [see Abstract 400 (1935)]. No marked dispersion is found in a number of organic liquids, including ethyl bromide, although dispersion might be expected in this substance due to a mechanism of the type shown by Kneser to exist in polyatomic gases. A slight dispersion is found in water but of sign opposite to that predicted by Kneser's theory for dispersion in gases. The author points out that the relation between the velocity of propagation of elastic waves in electrolytes and the frequency is important in the theory of electrolytes. Measurements of the velocity of propagation of supersonic waves in saturated aqueous solutions of KBr and KI show that the velocity is diminished by increasing the frequency. In Part II the velocity of propagation of supersonic waves in acetic acid is measured in the frequency ranges 220–270 kc./sec. and 2400–3400 kc./sec. The velocity in the higher range exceeds that in the lower by about 1%. The author suggests that this dispersion is connected with the interaction of single and double acetic molecules. K. M. C.

1696. Sound Velocity and Chemical Constitution. S. Parthasarathy. *Current Science*, 6. *pp*. 322–323, *Jan.*, 1938.—A summary of results obtained in the determination of the velocity of supersonic waves in a number of organic liquids, and the effect upon it of the chemical constitution of the liquid. A. J. M.

1697. Velocity of Sound by Capillary Supersonic Interference. J. P. Cance. *Comptes Rendus*, 206. *pp*. 504–505, *Feb.* 14, 1938.—From the bottom of a vessel containing a liquid, two quartz piezoelectric oscillators, set at an angle with each other, give out longitudinal compression waves of the same frequency. At the surface of the liquid, stationary waves, forming troughs and crests are produced in the part where the two waves overlap. The distance d between consecutive interference fringes is measured by a microscope and the frequency N of the oscillations by a wave-meter. The velocity of the supersonic waves in the liquid is $V = 2Nd \cos\alpha$, where α is the common angle of the quartz with the bisecting plane. For toluene the result $V = 1325$ m./sec. is in agreement with the value already known. H. M. B.

1698. Time of Closure of Glottis from Records of Vowel Sounds. F. Trendelenburg and W. Trendelenburg. *Preuss. Akad. Wiss. Berlin, Ber.* 20. *pp*. 265–277, 1937.—Examination of records of the vowels, chiefly ah, ay and ee, sung by alto and bass voices, lead to the following results. Values for the duration of the opening of the glottis can be determined from records of sung or spoken vowels of low pitch, either alone or in words, if, besides the curve for the complete sound, filtered curves are also recorded in which only the high-frequency regions of the partials (1200 and higher) are taken. In the filtered curves, two groups of vibrations or vibration maxima are to be found in each period of vibration of the fundamental, which correspond respectively to the opening and closing of the glottis. In both cases there is a sudden excitation of high-frequency vibrations in the middle of the throat above the glottis. [See also Abstract 5050 (1937).] G. E. A.

***1699. Improved Magnetostriction Oscillator. G. W. Pierce and A. Noyes, Jr.** *Acoustical Soc. of America. J.* 9. *pp*. 185–192, *Jan.*, 1938.—Description of a more convenient type of oscillating circuit than one previously given [see Abstract 2500 (1928)]. It consists of a two-valve amplifier coupled by an impedance, and input and output coils in which the magnetostrictive rod lies axially. A neon lamp serves as an indicator of oscillation. A discussion of the conditions necessary for oscillation is given. The twin oscillator is a modification which contains a double circuit for comparing and adjusting rod frequencies. The transverse vibrations of discs, strips, etc., in their natural frequencies is attained by fixing, perpendicularly to the plate, a short length of nickel tubing which projects into the rod coils. The instrument is useful for frequency calibration of electrical apparatus of all kinds. G. E. A.

See also Abstracts, 1382, 1388 and

1181B. Method of Harmonic Analysis. G. F. Partridge.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

1700. Recombination of Ions in Pure Oxygen as a Function of Pressure and Temperature. M. E. Gardner. *Phys. Rev.* 53. *pp.* 75–83, *Jan.* 1, 1938.—Using an outgassed chamber, the recombination coefficient in pure O_2 is found to be constant with time if the pressure remains constant. The value at N.P. and 25° C. is $\alpha = 2{\cdot}08 \pm 0{\cdot}05 \times 10^{-6}$. The variation of α with temperature and pressure agrees with Thomson's theory except at low temperatures, but this could be explained if the mass of the ions increased from 64 to 96. The results are not in accord with Langevin's theory, although the latter probably holds above a pressure of 10 atm. The change of recombination coefficient with time is found to be adequately accounted for by Loeb's approximate theory. F. C. C.

1701. Spectrum of Mobilities of Large Ions. Ouang Te-Tchao. *Comptes Rendus,* 206. *pp.* 240–242, *Jan.* 24, 1938.—The ions consisting of charged particles of smoke were caused to vibrate by an alternating electric field and were observed ultra-microscopically in a direction at right angles to the field. Their trajectories were photographed and from measurements of the length of the trajectories the mobilities of the individual ions could be derived. A curve is given showing the statistical frequency distribution of the values so obtained. W. S. S.

1702. Influence of Magnetic Field on the Potential Gradient in Plasma. E. Reichrudel and G. Spivak. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 1. *pp.* 177–179, 1938. *In English.*—The authors have previously suggested a quantitative method for the study of plasma by utilising the disturbance of the discharge by an external magnetic field [see Abstract 4317 (1936)]. Measurements were made of the potential gradient in argon, using a cylindrical tube with an oxide kathode. The tube length was about 1 m. and its diameter 4 cm. A magnetic field was supplied by means of a long solenoid fitted round the tube. Curves are given for the voltage gradients with discharge currents ranging from 40 to 400 mA and fields from 0 to 130 gauss. Similar curves are also given for Hg vapour at temperatures between 22° and 74° C. While for argon the curves show a general rise with increased fields, in the case of Hg vapour a maximum gradient is found at field values of 20 to 30 gauss, the steepness of fall beyond this maximum being greater the lower the temperature. An increase of losses due to elastic collisions with gas atoms may be expected from the apparent increase of pressure, but there is also a marked decrease of the coefficient of electron diffusion towards the walls of the discharge tube. While the former may result in an increase of the gradient, the latter may act in the opposite sense. Moreover, the magnetic field may change the inelastic energy losses of electrons. It does not seem possible to account fully for the results obtained until a quantitative theory of plasma in a magnetic field is developed. A. W.

1703. Excitation of Gases. Part II. W. Hanle. *Die Physik*, 6. 1. *pp*. 33–46, 1938.—A survey of recent work, continuing a previous survey [see Abstract 2593 (1934)], includes the work done on excitation by electrons, light, atoms, ions and concludes with a brief section on recent applications to lighting and a list of books and articles on the field considered. J. E.

1704. Excitation of Atomic Jets by Electronic Bombardment. R. Planiol. *Ann. de Physique*, 9. *pp*. 177–235, *Feb*., 1938.—An atomic jet is crossed by an electron stream and the resulting ions extracted in a direction normal to that of the rays. A high vacuum is preserved round the jets. Currents up to $700\,\mu$A have been obtained and higher ones are projected. The spectra observed show arc and spark lines, the former decreasing with increased speed of electrons. Lines almost up to X-ray emission can be produced. H. G. C.

1705. Effect of Kathode Material on the Second Townsend Coefficient for Ionisation by Collision. W. E. Bowls. *Phys. Rev*. 53. *pp*. 293–301, *Feb*. 15, 1938.—Measurements were made of the Townsend coefficients for ionisation by collision in pure N_2 and also in N_2 contaminated by Na or Hg vapour. Kathodes of Pt, Na and Hg were used. Values of α/p in N_2 contaminated by Hg vapour agree with the values found by previous investigators using N_2 of similar purity. With pure N_2 at the lower pressures and higher X/p, the values were 17% lower than the corresponding values in the Hg contaminated N_2. At high pressure and low X/p, the curves differed by relatively little. With Na contamination a larger increase in α/p was observed. Explanations of these results are suggested. The shapes of the β/p curves plotted as functions of X/p show abrupt rises at certain values of X/p, definite plateaux and subsequent gradual increases. These effects have not previously been observed in previous investigations in which Hg contamination has been present, the curves in that case rising asymptotically. The results obtained are discussed with reference to surface work functions, energy levels and secondary emission. A. W.

1706. Bolometric Measurement of Ionic Rays. E. Leimberger. *Phys. Zeits*. 39. *pp*. 150–155, *Feb*. 15, 1938.—Kinetic energy of slow ions is determined with a vacuum bolometer. For constant current, the energy was found to be proportional to the accelerating potential up to about 1200 V. The sensitivity of the bolometer was $(1\cdot3 \pm 0\cdot1) \times 10^{-8}$ W/sec. It is suggested that a bolometer which had been calibrated with ions could then be applied to find the intensity and velocity of neutral corpuscular rays. F. C. C.

***1707. Triode Valve Scale-of-Two Circuit. H. Lifschutz and J. L. Lawson.** *Rev. Sci. Instruments*, 9. *pp*. 83–89, *March*, 1938.—A valve scale-of-two is described using triodes. Accurate high speed tests of the resolution time showed this to be $6\cdot5 \times 10^{-6}$ sec. New methods of interpolation are also presented. AUTHORS.

See also Abstract 1733 and
1153B. Breakdown of Compressed Nitrogen in Small Gaps. I. M. Goldman.

CONDUCTION IN SOLIDS AND LIQUIDS.

1708. Conduction in Polar Crystals. Part I. N. F. Mott and M. J. Littleton. Part II. N. F. Mott. Part III. R. W. Gurney and N. F. Mott. *Faraday Soc., Trans*. 34. *pp*. 485–511, *March*, 1938.—In

Part I a method, based on Born's lattice theory, is developed for calculating the polarisation round any lattice point in a polar crystal which contains an excess charge. The method is used to obtain the work required to form vacant lattice points of either sign in alkali-halide crystals. It is thus possible to estimate the concentration of vacant lattice points in these crystals in thermal equilibrium. According to the theories of Wagner, Jost and others, these vacant lattice points are responsible for the electrolytic conductivity. The activation energy for the motion of such a hole is evaluated, and the results compared with the observed conductivity of NaCl.

In Part II the absorption spectra of metals and of polar salts are contrasted. An interpretation of the u.v. absorption spectra of the alkali-halides is given which enables the energies of the " conduction bands " in these crystals to be deduced from them, making use of the calculations of Part I. From these results the photoelectric threshold of rock-salt coloured by colloidal metal is deduced, and compared with experiment.

In Part III a hypothesis due to de Boer of the nature of the F-centres in alkali-halides crystals is discussed. The hypothesis accounts qualitatively for the drop in the photoelectric current at low temperatures and for the various ways in which F-centres may be formed. Making use of the calculations of the last two papers and certain further experimental data, the energy of formation of an F-centre in a crystal in contact with alkali metal vapour is calculated ; the results are in good agreement with experiment. AUTHORS.

1709. Effect of Cold Working and Heat Treatment on the Electric and Magnetic Properties of Pure Nickel. Part I. Drawn Nickel Wire. H. Bittel. *Ann. d. Physik*, 31. 3. *pp.* 219–244, *Feb.*, 1938.—The physical properties of a pure metal are changed by cold working, and on heating the metal within a given temperature range, recovery takes place. For most metals the various changes of properties have the same temperature of recovery, but this is not true for Ni. A Ni wire was drawn down to about a third of its original diameter with increase of electrical resistance which was removed by tempering at 349–450°. When tempered above 600°, a great increase in resistance took place, but with tempering above 800° the resistance is again reduced. Data are given of the changes in the temperature coefficient of resistance, the effects of magnetic fields, parallel and cross, in setting up magnetic anisotropy, the changes in coercive force and remanence, and the anisotropy which is present in a wire heated by a current but not in a wire heated in an oven. The magnetic and electric properties of the drawn wire, and the recovery effects, can be explained by assuming that strong internal stresses are set up as the result of the cold working. G. E. A.

1710. Surface Conductivity of Ceresin-Coated Quartz. C. H. Hou. *Rev. Sci. Instruments*, 9. *pp.* 90–91, *March*, 1938.—The surface conductivity of clear fused quartz in a humid atmosphere is found to be greatly increased, rather than decreased, by coating the quartz with a thin layer of ceresin wax. Humidity was controlled by the addition of a measured quantity of water to a known volume of thoroughly dried air. AUTHOR.

1711. Influence of Magnetic Fields on Persistent Currents in Supraconductors. K. C. Mann and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 31. *Sect.* III. *pp.* 19–29, *May*, 1937.—Measurements are described dealing with the decay of persistent currents passing through single crystals of tin in both longitudinal and transverse magnetic fields of varying strengths. The apparatus employed is described in detail. It is found that the "characteristic ratio" $r = H_t/H_c$ where H_c is the time critical field and H_t the corresponding transverse field at the point of zero potential current for supraconducting cylinders is not 0·5 as suggested by the old theory but has the value 0·575 at 3·22° K, and is a linear function of temperature over the range studied. At the transition point r appears to approach the value of 0·5. It is shown that penetration of the crystal begins long before resistance returns at certain temperatures, and hence concluded that the onset of the intermediate state is not necessarily accompanied by a finite resistance, but can still support a considerable persistent current, the magnitude of which depends on temperature. [See following Abstract.] R. L.

1712. Resistance of a Supraconductor in the Intermediate State. H. G. Smith. *Roy. Soc. Canada, Trans.* 31. *Sect.* III. *pp.* 31–39, *May*, 1937.—In his theoretical discussion London [see Abstract 3311 (1936)] neglected the surface penetration of the magnetic field into the supraconducting portions of the mixed phase. In this mathematical paper it is shown that by taking account of this the theory of the intermediate state can be brought into agreement with the experimental facts without any essential modification. The theory shows that departures from the ideal $r = \frac{1}{2}$ may be very much more noticeable than departures from the ideal magnetic behaviour in nearly pure samples, where r is the "characteristic ratio" of Mann and Wilhelm [see preceding Abstract]. It also appears that the surface energy must be principally associated with boundaries between supraconducting and normal regions, across which the metal itself is homogeneous. R. L.

1713. Current Distribution in Supraconductors. M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 240–245, 1937.—Two theories regarding the distribution of current in supraconductors are dealt with; according to one the current is localised at the surface so that no internal magnetic field is produced, whilst the other postulates a distribution similar to that of two parallel wires, for which the magnetic energy has a minimum value. Theoretical support is given to this latter assertion, and both hypotheses are shown to be consistent with London's theory of supraconductivity. R. W. P.

1714. Equilibrium of Supraconductors. N. Felici. *Comptes Rendus*, 206. *pp.* 242–244, *Jan.* 24, 1938.—It is shown that the distribution of the electric and magnetic field and currents in and near a supraconductor is uniquely determined if it be assumed that there is no magnetic field inside and that Ampère's law holds. R. P.

***1715. Non-Ohmic Resistance for Use with Geiger-Müller Counters. G. P. S. Occhialini.** *Journ. Sci. Instruments*, 15. *pp.* 97–99, *March*, 1938.—A method is described by which an ordinary valve can be used as a photo-cell to replace the ohmic resistance usually used with a Geiger-Müller counter. AUTHOR.

See also Abstracts 1380, 1671, 1722, 1741, 1744 and

1168B. Measurement of Minute Alternating Currents. S. R. Khastgir.
1169B. Measurement of D.C. Potentials in Circuits of High Resistance. R. H. Cherry.
1354B. D.C. Amplifier for Photo-Cells. R. W. Gilbert.
1408B. Method of Stabilising Anode Currents. R. Pinoir.

DIELECTRICS AND CAPACITANCE.

1716. Dielectric Constant Study of ω-Hydroxydecanoic Acid Polymers. J. Wyman. Jr. *Am. Chem. Soc., J.* 60. *pp.* 328–329, *Feb.*, 1938.—Measurements of the polarisations of ω-hydroxydecanoic acid polymers of average molecular weights from 1715 to 28650 show that there is no anomalous dispersion up to frequencies of $4 \cdot 8 \times 10^7$ c./sec. The polarisation per gram is independent of polymer size, and is the same as that calculated on the assumption that the polarisations of each molecule is the sum of the polarisations of the various polar groups which it contains. This indicates that owing to free rotation about the intervening C–C linkages each polar group orients in the field without restriction from the rest of the molecule. AUTHOR.

1717. Dielectric Properties of Aqueous Solutions of Salts. W. J. Dunning and W. J. Shutt. *Faraday Soc., Trans.* 34. *pp.* 467–479, *March*, 1938.—The force method for the determination of dielectric constant has been modified with a view to rendering it a precision technique for l.f. a.c. measurements on conducting solutions. Details are given of precautions to be adopted and corrections to be applied. The dielectric constants, relative to water, have been determined for solutions of salts of various valence types up to concentrations of 0·02–0·06 *N*. at 20° C., and at a frequency of 1000∼. A reproducibility to ± 0·1% has been obtained for these results. For each salt solution the results conform to an equation of the form $\epsilon - \epsilon_0 = A\sqrt{\gamma^*} - \epsilon_0 k\gamma^* + \epsilon_0 K\gamma^{*2}$. ϵ_s is the dielectric constant of the salt solution relative to that of water (ϵ_0); γ^* is the equivalence of the solution; A is the Debye-Falkenhagen expression, which holds in dilute solution; k interpreted in terms of the Sack effect of saturation of solvent dipoles. The factor $K\gamma^{*2}$ may be explained either in terms of the Bjerrum theory of ion association or by the desaturating effect which might be expected to arise in the more concentrated solutions through the closeness of the individual ionic fields. The latter interpretation is considered the more probable. AUTHORS.

1718. Dielectric Constants of Zwitter-Ions and Polar Molecules as Related to pH. W. J. Dunning and W. J. Shutt. *Faraday Soc., Trans.* 34. *pp.* 479–485, *March*, 1938.—The force method has been applied to the determination of the dielectric constants of 0·2 *M*. glycine and 1·0 *M*. urea at various values of pH. The dielectric constants of the glycine solutions remain unchanged for values of pH lying between about 4·5 and 7·0, but fall when the pH is outside that range. It is shown that the ionisation constants of glycine can be calculated from the form of the dielectric constant—pH curve by assuming that the rise in dielectric constant, above that of water, is proportional to the concentration of zwitterion. The dielectric constant of 1·0 *M*. urea is unaltered by change of the acidity of the solution from pH 2·0 to pH 11·5. It is concluded that urea in aqueous solution is not zwitterionic but is rather to be regarded as a very weak base with a high permanent dipole-moment. AUTHORS.

1719. Dipole Moments of Unsaturated Compounds. Part II. M. Gorman, R. M. Davis and P. M. Gross. *Phys. Zeits.* 39. *pp.* 181–185, *March* 1, 1938.—The present investigation shows that the previous hypothesis [see Abstract 356 (1933)] of a CH-bond moment with reversed polarity for unsaturated compounds of the ethylene and acetylene type is valid also for some recently studied substances, *viz.*, 1 : 1′-diphenyl-2 : 2′-dimethyl ethylene, phenyl ethylene, and the high and low melting isomerides of β-bromostyrene. Measurements are recorded which were made using both benzene and CCl_4 as solvents in order to establish whether the anomalous moments found for the unsaturated compounds may be ascribed in part to the solvent. It is concluded that the difference in value of the dipole moments in the two solvents is probably due to a change in equilibrium of isomeric forms. The paper is replete with data. H. H. Ho.

1720. Electrical Properties of Solids. Parts II and III. R. M. Fuoss. *Am. Chem. Soc., J.* 60. *pp.* 451–460, *Feb.*, 1938.—The conductance of polyvinyl chloride plasticised with 40% tricresyl phosphate, is made up of two parts, an electrolytic conductance and a pure a.c. response which is practically independent of frequency over the range 15–3 × 10^6 ∼. The electrolytic conductance varies exponentially with reciprocal temperature. The a.c. loss factor changes only slowly with temperature. The dielectric constant is approximately a linear function of the logarithm of the frequency over a fairly wide frequency range, and increases with increasing temperature above 60 ∼. In Part III experimental data on the dependence of conductance on voltage for polyvinyl chloride–tricresyl phosphate are presented. The results are interpreted in terms of a simple theoretical analysis. For a slab of material whose surfaces are kept at a fixed temperature, the maximum voltage at which a steady state is possible is determined explicitly by the specific resistance, and its temperature coefficient, the thermal conductivity and the surface temperature. Electrical failure will occur at voltages exceeding this critical value, and thermal failure may occur at lower voltages. [For Part I see Abstract 5076 (1937).] AUTHOR.

1721. Measurement of Capacitance by Ballistic Methods. N. F. Astbury and L. H. Ford. *Journ. Sci. Instruments,* 15. *pp.* 94–97, *March,* 1938.—The note describes a simple and convenient method by which a capacitance can be measured ballistically in terms of a mutual inductance, which can be either fixed or adjustable. The constants of the galvanometer are eliminated from the equations, and the accuracy claimed is 0·1%. The normal range, which is readily extended, is from 0·1 to 1 μF. AUTHORS.

1722. Anomalous Charge and Discharge Currents in Dielectrics. E. Hippauf and R. Stein. *Phys. Zeits.* 39. *pp.* 90–98, *Jan.* 15, 1938.—Describes measurements of the currents flowing in dielectrics at very short times after charge and discharge. The currents are amplified, and recorded by means of an oscillograph. Results on paraffin wax, cable oils and condensers with mica and paraffined-paper as dielectric, showed that the current (i) even at times of the order of 0·004 sec. after charge or discharge, can be represented by the well-known relation : $i = At^{-m}$. E. R.

See also Abstracts 1375, 1600.

ELECTROCHEMISTRY.

1723. Electrolysis of Metallic Perchlorates in Cellosolve. J. L. Beal and C. A. Mann. *J. Phys. Chem.* 42. *pp.* 283–300, *Feb.*, 1938. —Both the dielectric constant of the monoethyl ether of ethylene glycol and the conductance of its solutions are between those of methyl and ethyl alcohols. The monoethyl ether of ethylene glycol may be considered as an alcohol of high molecular weight, and as such the high molecular weight does not, in this case, show the usual effect of decreasing conductance. The polarisation curves show that metals even as reactive as Ba may be electrodeposited from solutions in the monoethyl ether of ethylene glycol. Although anhydrous solutions of aluminium perchlorate may be prepared in this solvent, the polarisation curves show no tendency toward the electrodeposition of Al from such solutions. AUTHORS.

1724. Electrolytic Separation of Deuterium; Influence of Temperature and Current Density at Various Kathode Metals. H. F. Walton and J. H. Wolfenden. *Faraday Soc., Trans.* 34. *pp.* 436–449, *March,* 1938.—The separation of the isotopes of H has been investigated under carefully controlled conditions of electrolysis, excluding contaminations from the kathode and using current densities of 1 mA/cm^2. and below. Separation factors were measured at five kathode metals, and the effects of temperature and current density determined. Experiments were also made on the separation in presence of catalyst poisons. The kathodes investigated seem to fall into two groups; in one group, Ag, Pt and Ni, with separation factors at room-temperature of 5 to 7, falling considerably with rise of temperature, and in the other, Hg and Sn, with separation factors of about 3. At Hg, the separation factor falls only slightly with temperature, while at Sn, it actually rises with rise of temperature. The effects of current density are small but in most cases definite. The rise of separation factor with temperature at Sn is anomalous, but with this exception, the results may be plausibly explained by the theory of alternative discharge mechanisms, "catalytic" and "electrochemical," advanced by Horiuti and Okamoto. The data are discussed in relation to this and other theories of H overpotential. A study of the overvoltage of the H isotopes at a Hg kathode by F. P. Bowden and H. F. Kenyon, which will shortly be published, is very relevant to the above work. Their conclusions regarding the mechanism of discharge at mercury are compatible with those of the authors. AUTHORS.

1725. Application of Halide Reference Half-Cells to pH Determinations. W. J. Hamer. *Am. Electrochem. Soc., Trans.* 72. *pp.* 45–69; *Disc.,* 69–70, 1937.—The electrode potentials of the three types of calomel half-cells are determined from thermodynamic data and compared with the values obtained from galvanic cell measurements which include liquid junction potentials. For the latter calculations, the latest developments in liquid junction potentials are presented and the values of the potential for the liquid junction between various concentrations of HCl and KCl were calculated. Values of the potentials to be assigned to the reference half-cells for different types of service are grouped into three classes: standard potentials, potentials when used with strong acids, and potentials when used with weak buffers. An e.m.f. method independent of liquid junction potentials is proposed for the determination of the pH of unknowns. In this method, a definite amount of NaCl is added to the unknown and the AgCl electrode is used directly in the unknown. The method is illustrated for phosphate buffers. AUTHOR.

***1726. Standard Potential of the Silver-Silver Azide Electrode. A. C. Taylor and L. F. Nims.** *Am. Chem. Soc., J.* 60. *pp.* 262–264, *Feb.,* 1938.—The preparation of a stable reproducible form of the silver-silver azide electrode is described. The standard potential of the silver-silver azide electrode has been determined at 10° intervals from 5 to 45°. The solubility of silver azide has been estimated to be $5 \cdot 1 \times 10^{-5}$ mol./l. at 25°. AUTHORS.

1727. Palladium Kathode in Chromic Acid Solutions. E. Müller. *Zeits. f. Elektrochem.* 44. *pp.* 199–204, *March,* 1938.—When a solution of chromic acid is electrolysed with a Pt kathode H_2 is given off, if with one of Pd the H_2 is absorbed by the Pd. In neither case is the H_2 oxidised by the chromic acid. This is due to formation of a film of $Cr(OH)CrO_4$ on the metal, the pores of which are so small that only H ions, and not those of the chromic acid, can pass through; though the film is transparent to $FeCl_3$ or $KMnO_4$. The mechanism of this action is discussed in detail, and two methods based on these facts are described for determining small amounts ($\not> 2\%$) of H_2SO_4, in a solution of CrO_3, are described. C. A. S.

1728. Mechanism of Hydrogen Overvoltage. S. v. Náray-Szabó. *Zeits. f. phys. Chem.* 181. *Abt.A.* 5. *pp.* 367–374, 1938.—The hydrogen overvoltage was measured on kathodes of Pt, Ag, Cu and Hg in solutions of $2N \cdot HCl$ and H_2SO_4. After complete saturation of the kathode surface with H_2 the values obtained were reproducible and were in agreement with the Tafel equation. The dependence of the magnitude of the overvoltage upon the degree of saturation was particularly striking in the case of Pt. Two stages in the phenomenon of overvoltage were recognised, the discharge mechanism of the kathode fully saturated with H_2, and the adsorption mechanism on the active surface of the kathode incompletely saturated with H_2. The difficultly reproducible transition forms corresponded to partial saturation. F. J. B.

See also Abstracts 1685, 1686.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

1729. Spin Angular Momentum of the Electron. U. Kakinuma. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 755. *pp.* 187–193, *Feb.*, 1938. *In English.*—In extension of previous work dealing with electron theory [see Abstract 2370 (1936)], it is shown that the intrinsic spin angular momentum of the electron has the value $h/2$. J. S. G. T.

1730. Diffusion of Electrons in a Magnetic Field. J. S. Townsend. *Phil. Mag.* 25. *pp.* 459–470, *March*, 1938.—The method of determining the effect of a magnetic field on the rate of diffusion of electrons in a gas, given some years ago by Townsend, has recently been criticised by Tonks [see Abstract 2804 (1937)]. Detailed consideration of the argument advanced by Tonks shows that it is far from logical and, in particular, that the conclusions arrived at by him without considering the effect of space-charges cannot be regarded as evidence of any inaccuracy in equations of motion. The principal difficulty in arriving at a satisfactory explanation of the properties of discharges in gases depends on the determination of the space-charges, and this difficulty would be much greater for fluctuating currents of the order of 2500 A in rectifiers than for small d.c. discharges. It is pointed out that the velocities u, v and w of Townsend's theory are not the actual velocities of the electrons and that the equations involving them are frequently misunderstood. An explanation is therefore given showing to what extent they contribute to the theory of the motion and equations are obtained which completely represent the mean effects of the action of the applied magnetic force. Experiments carried out on very small photoelectric currents, when there was no appreciable force due to space-charges, have given results in good agreement with theory. A. W.

See also Abstracts 1473, 1583, 1740.

ELECTROSTATICS.

1731. Removal of Electric Charge by Current of Air. O. Yadoff. *Comptes Rendus*, 206. *pp.* 510–512, *Feb.* 14, 1938.—A jet of filtered air of variable humidity (H) and velocity (V) impinged on (1) a freely suspended brass sphere, and (2) on a fusiform brass body in a tube. With (1) increase in the rate of discharge became appreciable when V = 385 m./sec. and H = 40. With V = 410 m./sec. and the same H discharge was 5 times as rapid as in free air. With (2) when H = 60 the rate of discharge was doubled as compared with the rate in still air, when the air was drawn along the tube. Both these rates were reduced to about half when H = 50. C. A. S.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1732. Change of Resistance of Aluminium Single Crystals in Strong Magnetic Fields at Low Temperatures. E. Justi and H. Scheffers. *Phys. Zeits.* 39. *pp.* 105–109, *Feb.* 1, 1938.—The electrical resistance of pure Al crystals at various temperatures below 78° Abs. are studied in strong magnetic fields up to 35 kG. It is found that (1) aluminium crystals show a very small anisotropy of resistance increase $\Delta\rho_1$ in transverse magnetic fields. (2) At constant low temperatures $T < 20°$ Abs. $\Delta\rho_1$ is only retarded with increasing magnetic fields. (3) A longitudinal effect $\Delta\rho_{11}$ appears which at 20° A is less than a third of the corresponding value of $\Delta\rho_1$ in transverse magnetic fields. (4) At constant field strength the increase of $\Delta\rho_1$ with temperature shows a maximum at about 40° A for a field strength of 18·7 kG. The interrelations between these effects are discussed. It is shown that only some of the phenomena are common to other metals. R. L.

See also Abstract 1709.

MAGNETISM AND ELECTROMAGNETISM.

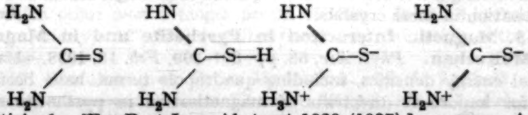
***1733. Effect of Fringing Flux in Large Magnets. J. D. Howe and I. Walerstein.** *Rev. Sci. Instruments*, 9. *pp.* 53–54, *Feb.*, 1938.—A cyclotron is designed with tapered pole-pieces to produce 20 eMV protons, and account is taken of the strong force of interaction, in large magnets used for this purpose, between the current in the energising coils and the fringing flux. The design allows a considerable saving in the Fe and Cu required, and also a smaller consumption of power than would be necessary for the same field between straight cylindrical or conical pole-pieces. A diagram shows a section of the pole, coil and fringing flux, and graphs give the value of H along the equatorial plane for various currents. The current in each coil for a field of 15200 gauss is 135 A. G. E. A.

***1734. Gaussian Approximation in the Heisenberg Theory of Ferromagnetism when $S > \frac{1}{2}$. J. H. van Vleck.** *J. Chem. Phys.* 6. *pp.* 105–106, *Feb.*, 1938.

1735. Magnetic Anisotropy of Naturally Occurring Substances. Part III. Wood and Its Constituents. P. Nilakantan. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 38–49, *Jan.*, 1938.—The diamagnetic anisotropy and absolute susceptibilities of wood, lignin and wood cellulose have been determined. It has been found that the "crystalline" element in wood is definitely cellulose and that lignin and the hemi-celluloses make no contribution to the magnetic anisotropy, suggesting either a random orientation if they are crystalline or an amorphous structure. In the light of evidence from other sources, it seems most likely that they are amorphous. The anisotropy measurements also indicate that the direction of maximum diamagnetic susceptibility in the cellulose molecule is along the length of the chain. Since it is also known that the direction of maximum electric polarisability too is along the chain length, the author finds that these directions coincide in the molecule just as in the case of the higher long-chain saturated hydrocarbons. [For Part II see Abstract 917 (1937).] AUTHOR.

1736. Magnetic Anisotropy of Tutton Salts. M. S. Joglekar. *Zeits. f. Krist.* 98. 5–6. *pp.* 411–417, 1938. *In English.*—Mixed crystals, A+*n*B, where A and B are $(NH_4)_2M(SO_4)_2 \cdot 6H_2O$, and M in A (paramagnetic) is Fe'', Co'', Ni'' or Cu'' and in B (diamagnetic) Mg or Zn, were prepared from the mixed solutions; *n* must be determined by actual analysis, as it differs from the ratio of the salts in the solution. The directions of the principal axes of magnetic susceptibility, χ_1, χ_2 in the (010) plane and the differences of χ_1, χ_2 from χ_3 the susceptibility, along the *b* axis, were determined for each of several values of *n* from 0 to 10·13. Results show the order of magnitude of the anisotropy of any paramagnetic ion to be the same at all dilutions, and other variations to be as might be expected from differences in atomic radii. C. A. S.

1737. Resonance in Urea and its Derivatives. Part II. Diamagnetics of Thio-Derivatives. A. Clow. *Faraday Soc., Trans.* 34. *pp.* 457–463, *March*, 1937.—The diamagnetic susceptibility of thio-urea and thirteen of its derivatives has been measured and applied to the problem of the structure of the thio-urea molecule, which is shown to be an amino-imino resonance hybrid. Substitution in the parent molecule causes a change in structure, the extent of which depends on the nature and number of the substituents. There is a close analogy between the changes in thio-urea and those in urea, and these are in qualitative agreement with the earlier suggestions of E. A. Werner. The arguments put forward in favour of the structures:—



are criticised. [For Part I see Abstract 1829 (1937).] AUTHOR.

1738. Paramagnetism of the Iron Group. S. S. Bhatnagar, M. L. Khanna and M. B. Nevgi. *Phil. Mag.* 25. *pp.* 234–241, *Feb.*, 1938.—Values for anhydrous organic salts of Co and Ni are recorded and compared with existent data. W. R. A.

1739. Temperature Variation of Electron Spin Paramagnetism: Numerical Results. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 403–415, *Jan.*, 1938.—Calculations are made of the temperature variation of electron spin paramagnetism due to electrons in unfilled electronic energy bands of the standard form. The theory has been previously developed [see Abstract 2886 (1936)] and calculations have been made by series methods which are accurate only for high and very low temperatures (for $kT/\epsilon_0 > 1$ and $kT/\epsilon_0 \ll 1$, where ϵ_0 is the Fermi zero point energy). In the method developed here, the computations are made with the aid of tables of the basic Fermi-Dirac functions (McDougall and Stoner), enabling a precision of within 1 in 10^5 to be attained for the whole temperature range. A comparison is made between the results obtained by the present and the series methods. Finally, the values are tabulated in a manner convenient for consideration in connection with experimental data, $q/\chi_A V_0$ being given as a function of T/V_0, where χ_A is the gram atomic susceptibility, V_0 the Fermi zero point energy in electron volts, and q the number of electrons per atom in the energy band. The possible degree of precision is here limited by uncertainties in the values of the physical constants, particularly e, m and h, involved in the conversion factors; the effect of these uncertainties is briefly discussed. AUTHOR.

1740. The Electron and Limits to the Precision of Electromagnetic Field Specifications. W. H. Watson. *Roy. Soc. Canada, Trans.* 31. *Sect.* III. *pp.* 47–56, *May*, 1937.—The uncertainty relations for an electromagnetic field $\Delta E_z \Delta(yz) = c\Delta H_z \Delta(xt) = 2\pi e$ are applied to determine the corresponding uncertainties in the motion of an electron in the field. These uncertainties are shown to be equivalent to the effects of the electromagnetic field due to the electron's own magnetic and electric moments, based on a representation of the electron's field by means of operators, which is discussed in the paper. AUTHOR.

1741. Indeterminacy of the Electromagnetic Potentials. B. Kwal. *Comptes Rendus*, 206. *pp.* 238–240, *Jan.* 24, 1938.—A mathematical development of the notion of electromagnetic potentials, with de Broglie's theory of the photon and London's theory of supraconductivity in mind. W. S. S.

1742. Magnetic Interaction in Homogeneously Strained Ferromagnetic Crystals. L. W. McKeehan. *Phys. Rev.* 53. *pp.* 301–307, *Feb.* 15, 1938.—A well-known method of computing magneto-strains, as the strains necessary to minimise the sum of magnetic and elastic potential energies, is improved in detail, extended to include terms dependent upon the structure of atomic magnets, and is applied in the cases of body-centred cubic Fe, face-centred cubic Ni and hexagonal close-packed Co. It is shown that magnetostriction is not important in fixing directions of easiest magnetisation in these crystals. AUTHOR.

1743. Magnetic Interaction in Pyrrhotite and in Magnetite. L. W. McKeehan. *Phys. Rev.* 53. *pp.* 307–309, *Feb.* 15, 1938.—Magnetic potential energy densities, including quadrupole terms, have been computed for important directions of magnetisation in pyrrhotite and in magnetite. In pyrrhotite the results are in contradiction with experiment, suggesting that other cases of ferromagnetic anisotropy greatly predominate. In magnetite the results suggest that all the Fe atoms contribute to the ferromagnetism, neither ferric nor ferrous iron being adequate separately to explain the observed behaviour. With this assumption the results are in qualitative agreement with experiment, calculated anisotropy being greater than that reported in the literature of the subject. AUTHOR.

1744. Growth of Nuclei of Magnetisation at Large Barkhausen Discontinuities. W. Döring. *Zeits. f. Physik*, 108. 3–4. *pp.* 137–152, 1938.—The experiments of Sixtus are described and discussed and it is shown how they may be used to derive the energy conditions for the growth of a nucleus. There is a quantitative agreement with experimental results, a number of which are given in illustration. A correlation may also be effected with the results of Bloch. H. J. H. S.

See also Abstracts 1470, 1567, 1699.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1745. Electrical Studies of Living Tissue. Part II. Correlation between Tissue Response and Voltage Distribution. A. G. Conrad, H. W. Haggard and B. R. Teare. *Trans. A.I.E.E.* 57. *pp.* 1–4, *Jan.*, 1938.—Further to a previous paper [see Abstract 4383 (1936)] the response of physiological tissue to electrical stimulation is investigated. Such response has been attributed to polarisation phenomena and the authors produce evidence, illustrated by oscillographs, to show that a definite internal voltage has to be built up, corresponding to the threshold value, before response. The process is entirely analogous to electrical condenser discharge and is discussed from such mathematical aspects, circuits being shown which are considered equilvalent to frog and human tissue, which, as in the previous paper, differ in response. B. J. L.

***1746. Experimental Analysis of Rein's Thermostromuhr for Small Flows. J. F. Herrick, E. J. Baldes and F. P. Sedgwick.** *J. of Applied Physics*, 9. *pp.* 124–127, *Feb.*, 1938.—The experimental curve is determined which shows the relation between the flow of blood in cm^3./min. and the deflection of the galvanometer in mm. for a range of flows between zero and about 3 cm^3./min. The curve is similar to that calculated by Burton for the Rein thermostromuhr and that experimentally obtained by Jongbloed and Noyons with their aerothermorheograph. The maximal deflection of the galvanometer occurs at a flow (Ringer's solution) of about 0·08 cm^3./min. and for small or greater flows the deflection decreases. Since the deflection of the galvanometer approaches zero for very small flows and becomes zero for cessation of flow, whereas it usually decreases for increase of flow, one must be careful to distinguish between a cessation of flow and an increase. Difficulty will not arise if sufficient time is allowed for the establishment of thermal equilibrium. Certain controversies have arisen because this particular limitation of Rein's thermostromuhr was disregarded. The method, as used by the authors, is wholly unsuited for indicating variations in blood flow which occur in less than 60 sec. It may be very reliable for indicating changes in blood flow which occur over a longer period of time. In an *Appendix* **A. C. Burton** [*ibid. pp.* 127–131] describes the theory and design of the thermostromuhr. AUTHORS.

***1747. Simultaneous Cross-Radiation. M. A. Loebell.** *Am. J. of Roentgenology and Radium Therapy*, 39. *pp.* 274–277, *Feb.*, 1938.—For purposes of X-ray therapy a special tube is described, which has been used in actual practice, to permit cross-fire irradiation of a deep-seated tumour by a single treatment, so effecting economy of time with reduction of dosage to surrounding normal tissues. The tube is illustrated, operates at 200 kV in connection with a vacuum pump and has four anodes and kathodes symmetrically arranged to produce four converging beams of irradiation. Stray radiation is prevented since the electrodes are contained in a lead-covered steel chamber. Water or oil cooling may be used and the construction allows ready change of electrodes. B. J. L.

***1748. X-Ray and Electrical Protection with Reference to X-Ray Tubes. M. J. Gross.** *Am. J. of Roentgenology and Radium Therapy*, 39. *pp.* 278–285, *Feb.*, 1938.—Discusses historically the evolution of X-ray tubes since 1898, having glass or metal protection to prevent stray radiation, except *via* a window in the desired direction. Modern developments are in the direction of putting both the transformer and X-ray tube in a shock-proof tank, rather than putting the X-ray tube only in a tank. It is considered only a matter of time before non-shock proof apparatus becomes obsolete. B. J. L.

1749. Intensities for Short Distance Therapy. M. C. Reinhard and H. I. Goodale. *Radiology,* 30. *pp.* 221–224, *Feb.*, 1938.—The new shock proof tubes, enclosed in an insulating shell, emit X-rays which have been filtered through this material in addition to being filtered through the glass. This paper sets forth results of measurements of surface and depth intensities from such a shock-proof X-ray tube, operated at 100 kV.p. (half-value layer 0·9 mm. Al) for target-skin distances of 11–30 cm., and fields varying from 10 to 25 sq. cm. The results are given in tabular and graphical form. G. G.

1750. Wave-Length as a Factor in Radiotherapy. J. H. D. Webster. *Brit. J. of Radiology,* 11. *pp.* 108–111, *Feb.*, 1938.—It is pointed out that in comparison with other factors such as space and time distribution of absorbed radiation, wave-length is probably unimportant in dosage. Recent work on the subject is considered from three points of view; (1) theoretical and physical, (2) biological and experimental and (3) clinical. The general conclusion, on the evidence considered, is that there is little or no indication of a selective action of shorter wave-lengths, if all other factors are given due consideration. J. E. R.

1751. Biological Action of X-Rays. J. A. Crowther. *Brit. J. of Radiology,* 11. *pp.* 132–145, *March,* 1938.—This lecture reviews the experiments and theories of the ultimate action of X-rays on single cells. The theories fall into two main categories—the "poison" hypothesis and "target" hypothesis. The effect of the variation of temperature and intensity in irradiation experiments shows that the "poison" hypothesis cannot explain the events. Various mechanisms have been suggested for the "target" hypothesis—the absorption of a photon in a structure; the production of a pair of ions within the sensitive particle; and the passage of an electron through some sensitive target area. Experimentally determined survival and distribution curves seem to be best explained by the second of these mechanisms. In the experiments with u.v. light it is pointed out that the energy available is some one-thousandth of that in the X-ray experiments, and thus the results are hardly comparable. It seems to be that the action is definitely on the nucleus of a cell, and probably on the gene. G. G.

***1752. Nuclear Physics and Medicine. L. G. Grimmett.** *Nature,* 141. *pp.* 311–314, *Feb.* 19, 1938.—A critical survey is given of the different H.V. generating systems of 1-5 eMV now in use and under construction in U.S.A. and Europe, intended for the production of intense neutron beams, artificial radio-elements and for X-rays approximating in wave-length to the γ-rays of Ra. For therapeutical purposes, it is possible that neutrons will have a greater "selective action" than X-rays and inflict greater damage on malignant cells than on normal ones, while chemotherapy may be extended by the use of radio-isotopes of the common elements. The relative merits of the cascade transformer, the cyclotron, electrostatic generator of the endless-belt type, radio-oscillator resonance generator, cascade (voltage multiplier) and impulse generator are discussed in turn. The cyclotron is remarkably compact for its performance although the power consumption is heavy. Using ion currents less than 100 μA, the cyclotron has furnished the most powerful neutron beams yet obtained with which most of the biological work to date has been carried out. Over

25 are in the course of construction (two in England, Cambridge and Liverpool). The design of the electrostatic generator of the belt type operating in a compressed gaseous dielectric [see Abstract **906** (1937)] is likely to be influenced by the discovery of the remarkable insulating properties of the gas CCl_2F_2 known commercially as the refrigerant "freeon." The author deplores that, apart from the 400 kV neutron generator under construction at Mount Vernon and the 1000 kV X-ray plant in use at St. Bartholomew's Hospital, no other applications of these recent advances in pure physics to medical science are being made in England. T. A. C.

***1753. Small Flexible 2-Gramme Radium Unit. C. W. Wilson and N. H. Pierce.** *Brit. J. of Radiology*, **11.** *pp.* 189–198, *March*, 1938.—An account is given of the construction of a compact 2-gm. radium teletherapy unit, which is also arranged to allow the safe removal of a special 1-gm. source for contact irradiation. Details are given of the radiation fields available from the unit for radium teletherapy. AUTHORS.

1754. Mitogenetic Radiation. O. Glasser and H. Barth. *Radiology*, **30.** *pp.* 62–67, *Jan.*, 1938.—The existence of mitogenetic radiation has been a matter of dispute, some observers failing to detect it. The Authors have utilised the Geiger-Müller counter for detection of the radiation physically and cultures of yeast biologically, full details of the measurements so made being given and illustrated by curves. By further work it is hoped to give definite conclusions in respect to the problem of this radiation. B. J. L.

See also Abstract

1262B. Diathermy and Short Wave Therapy. W. E. Schall.

OSCILLATIONS AND WAVES.

1755. High-Latitude Radio Observations. A. B. Whatman and R. A. Hamilton. *Phys. Soc., Proc.* **50.** *pp.* 217–232, *March* 1, 1938.—Observations were made on the ionosphere for nearly a year at 80° 23′ N., 19° 31′ E. It was found that at local noon the E-region was present throughout the winter except on a few days which were magnetically disturbed. The electron-density in this region is at a minimum at midwinter and a maximum at midsummer. The F_1-region is observed at noon only during the summer months with maximum electron-density at midsummer. The annual variation of maximum ionisation in the F_2-region is irregular and not very great, but the electron-density is at a maximum in spring and in late autumn. The diurnal variation of electron-density in the F_2-region is more marked in the dark period, with a day to night ratio of 2·3 : 1, than in the summer solstice period when the ratio is 1·5 : 1. This latter figure which is also the ratio for the E and F_1 region is in fair agreement with the ratio of 1·63 : 1 deduced theoretically on the assumption that the ionising power is proportional to the altitude of the sun. In all cases the minimum is near midnight with maxima before and after noon and a subminimum near noon. The effect of magnetic storms is to increase the electron-density in the absorbing region below the E-region and, in the summer, to reduce markedly the electron-density in the F_2-region. Reflections from the persistent E-region persist to very high frequencies especially between 12·00 and 18·00 G.m.t. An intense E-region, with a high reflection coefficient, occurs at all seasons during magnetically quiet conditions, and occurs almost solely between 14·00 and 23·00 G.m.t. No special conditions in the ionosphere obtain when the aurora is overhead, and absorption is not usually markedly increased under such conditions. AUTHORS.

1756. Diurnal Variation of Ionospheric Absorption of Radio Waves. J. E. Best and J. A. Ratcliffe. *Phys. Soc., Proc.* 50. *pp.* 233–246, *March* 1, 1938.—Experimental determinations of the reflection coefficient of radio waves reflected from the F-region of the ionosphere are described. The afternoon variation of the reflection coefficient was investigated on several days between June and Dec. 1936. Days with a quiet ionospheric behaviour were chosen, and the tests made in choosing such days are described. The results can be explained on the assumption that the absorption occurs in the lower portion of a simple E-region of the type considered by Chapman. It is shown that the recombination coefficient must be independent of the pressure at heights above 110 km. at least, and that it must have a value not less than 10^{-8}. It is pointed out that this value does not fit in with the usually accepted theory. The absorption measurements are shown to be in agreement with Martyn's suggestion that the collisional frequency for electrons in the neighbourhood of the E-region is given by assuming that the value at a height of 90 ± 5 km. is 10^6 per sec. and that the scale-height of the atmosphere is 9 km.
AUTHORS.

See also Abstracts
1181B. Method of Harmonic Analysis. G. F. Partridge.
1386B. Sudden Ionospheric Disturbance. R. Bureau.

PHOTOELECTRICITY.

1757. Photoelectric Sensitisation of Aluminium. L. P. Thein. *Phys. Rev.* 53. *pp.* 287–292, *Feb.* 15, 1938.—It is shown that the increase in photo-currrent from Al which had been subjected to H_2 glow discharges, is dependent on the time of discharge and on the pressure of H_2. If the target is not outgassed a rapid decay is noted for sensitisation, because of diffusion to the surface of gas contained in the body of the metal. Results indicate that this sensitisation is due mainly to " clean-up " of the surface of the oxide-coated Al. Glow discharges have little effect on the yield from freshly evaporated Al. Another type of sensitisation is effected by exposing a freshly evaporated Al surface to minute quantities of dry air. The effect of the glow discharge upon a surface thus sensitised is one of desensitisation. The current-voltage data from freshly distilled Al yield a curve which fits well upon the theoretical curve of the DuBridge theory. The curves from surfaces sensitised with air show no agreement with the theory. The threshold value obtained from a film of Al approaching bulk thickness is 2840 Å. AUTHOR.

See also Abstracts 1495, 1564, 1708, 1715 and
1354B. D.C. Amplifier for Photo-Cells. R. W. Gilbert.

PIEZOELECTRICITY.

1758. Variations of Lattice Dimensions Produced by Electrostatic Forces in Piezoelectric Crystals. V. Dolejšek and M. Jahoda. *Comptes Rendus,* 206. *pp.* 113–115, *Jan.* 10, 1938.—The influence of electric force on the Bragg X-ray diagram was observed for an X-cut quartz plate, and the corresponding variations of lattice dimensions were deduced. The resulting values of strain are in agreement with the values calculated from the known piezoelectric constant of quartz. P. V.

See also Abstract
1406B. Modes of Vibration of Piezoelectric Quartz. J. Benoit.

THERMOELECTRICITY.

See Abstract 1380.